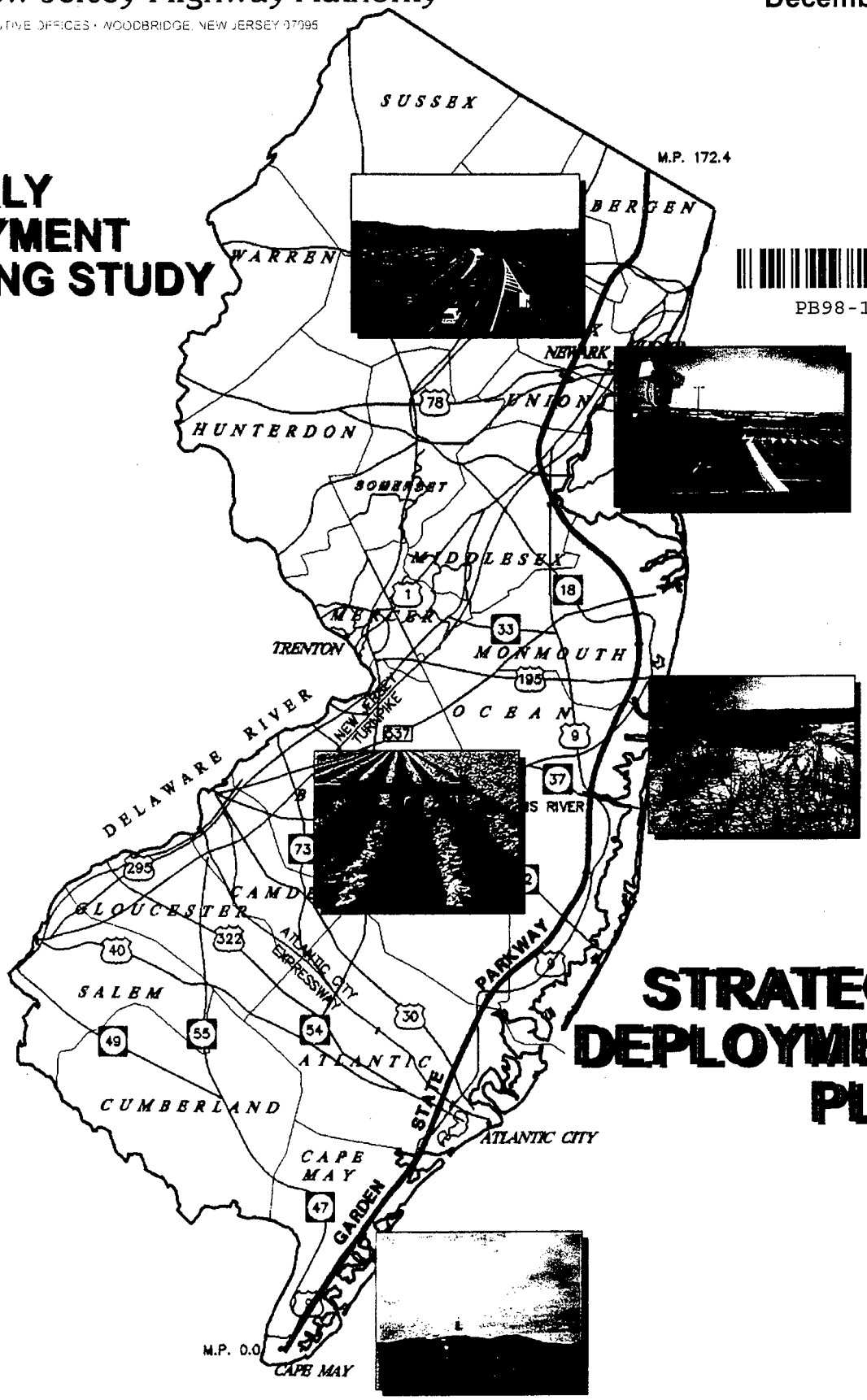
New Jersey Highway Authority
EXECUTIVE OFFICES • WOODBRIDGE, NEW JERSEY 07095

December 1997

ITS EARLY DEPLOYMENT PLANNING STUDY



STRATEGIC DEPLOYMENT PLAN

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New Jersey
Highway Authority

Garden State Parkway Corridor

ITS Early Deployment Planning Study

Strategic Deployment Plan

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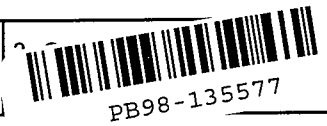
Technical Report Documentation Page

1. Report No.		3. Recipient's Catalog No.
4. Title and Subtitle Garden State Parkway Corridor ITS Early Deployment Study Strategic Deployment Plan		5. Report Date December 1997 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address Frederic R. Harris, INC. Iseling, New Jersey		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address New Jersey Highway Authority Executive Offices Woodbridge, New Jersey 07095		13. Type of Report and Period Covered 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

This Strategic Deployment Plan describes ways of improving travel within the Garden State Parkway Corridor using Intelligent Transportation Systems. Travel improvements will be possible with systems that enhance operations of existing facilities and methods of disseminating information that travelers can use to make better decisions on when to travel, what mode to use, and which route to take.

This report documents the projects that are recommended for short term implementation and how those projects address the user needs in the corridor. It describes these projects, their costs and benefits, and other information that will be useful in helping to implement and operate these projects. The report also presents the larger context in showing how these projects fit into an overall ITS program for the corridor.

17. Key Words	18. Distribution Statement		
Early Deployment Plan	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 146	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Garden State Parkway Corridor
ITS EARLY DEPLOYMENT PLANNING STUDY

Strategic Deployment Plan

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INTRODUCTION AND VISION

1.1 INTRODUCTION

This Strategic Deployment Plan describes ways of improving travel within the Garden State Parkway Corridor using intelligent transportation systems (ITS) and without constructing additional roadway lanes. Travel improvements will be possible with systems that enhance operations of existing facilities and methods of disseminating information that travelers can use to make better decisions on when to travel, what mode to use, and which route to take.

This study follows the planning process developed by the Federal Highway Administration. Figure 1-1 depicts graphically this process from identification of corridor needs through development of alternative solutions, to recommendations for a comprehensive plan, and finally to implementation and evaluation of the plan. The ITS planning process is based on identifying the transportation needs of the area and developing a series of improvements that respond to those needs. In the Garden State Parkway Corridor this would include the needs of the travelers who use the Parkway facilities and services, the transportation systems operators of the various in the corridor, and the communities through which people travel.

One of the unique aspects of the ITS planning process is that it looks at travel from the transportation users' viewpoint, across agency boundaries and modes. It is concerned with the complete trip made by the traveler in the corridor, including the points where the traveler may change from a roadway operated by one agency to another, the locations where people change modes, and the operation of the various modes. The process also recognizes the importance of the commercial activities that are supported by the transportation infrastructure.

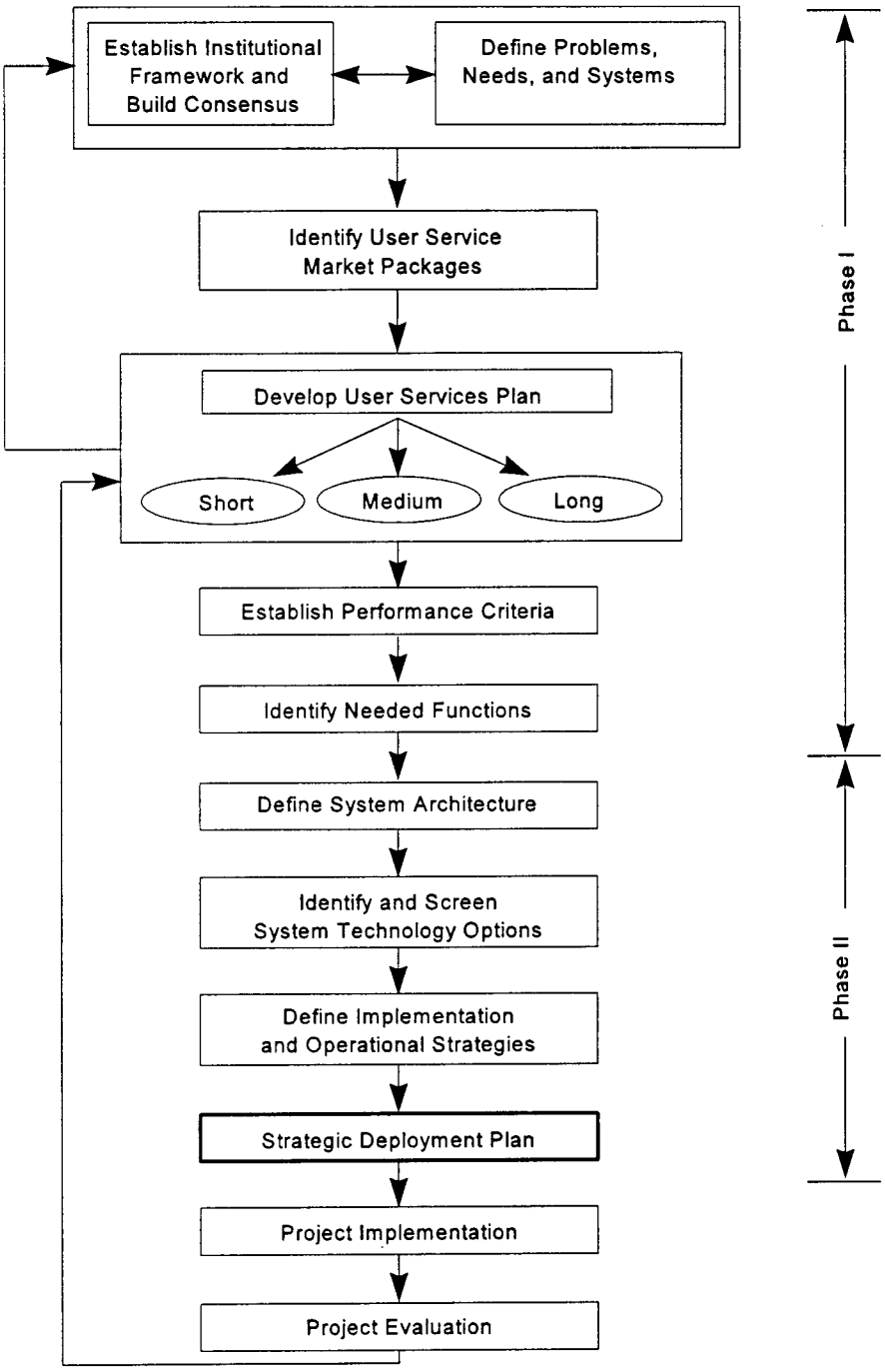
This report documents the projects that are recommended for short-term implementation and how those projects address the user needs in the corridor. It describes these projects, their costs and benefits, and other information that will be useful in helping to implement and operate these projects. The report also presents the larger context in showing how these projects fit into an overall ITS program for the corridor.

1.2 VISION FOR TRANSPORTATION IN THE CORRIDOR

"Improving traffic flow, travel choices and safety by using advanced technology in the Garden State Parkway Corridor."

Figure 1-1

ITS PLANNING PROCESS



This "Vision Statement," developed by the project's Steering Committee, succinctly states the overall goals and focus of this study. The following paragraphs present a series of future travel scenarios that could be made possible through the achievement of this vision.

1.2.1 Park and Ride

In the future, an increasing number of travelers will drive their cars to a park and ride facility somewhere in the corridor and ride a transit bus for the remainder of their trip to work. Sufficient parking space will be available almost all of the time. Electronic equipment will monitor the use of the lot using the E-ZPass electronic toll tag, which may also be used to collect a nominal fee to defray the costs of expanding and operating these facilities. When a facility is full, the VMS (variable message sign) and HAR (Highway Advisory Radio) systems will direct drivers to other facilities where space is available.

Commuter transit service at the park and ride facilities will be readily accessible, comfortable and convenient. Bus shelters will provide protection from inclement weather. Real-time information— the arrival time of the next bus on each route, for example—will be displayed. Systems will be in place that allow riders to request service from routes that stop only on demand. Patrons will be able to pay the fare using either cash or an electronic fare media. Limousine service and charter bus service will be available from selected facilities to airports and other major destinations. CCTV cameras will be installed at locations where safety is a concern.

1.2.2 Transit

Bus operators will be able to know where their vehicles are and when they are running late. They will broadcast this information to patrons waiting at the park and ride facilities. Some transit operators may only have their buses stop at a park and ride facility when someone is waiting. These operators will have systems that monitor requests for service, identify the next available vehicle, signal the driver to pick up a passenger, receive an acknowledgment from the driver, and display the estimated arrival time to the waiting patron. They will also communicate this data to the information service providers, so that the public can be advised of major storms or accidents that cause travel delays.

Bus operators will also receive real-time information on the preferred route to use when parallel or alternate routes are available, and will communicate this to their drivers. Bus operations in the corridor will be expedited by High Occupancy Vehicle (HOV) travel lanes and toll lanes wherever feasible.

1.2.3 Carpool Operations

People riding to and from work in carpools will rendezvous on local streets in the corridor or at the park and ride facilities. People who want to form or join a carpool will be able to exchange information electronically through the various carpool matching services in the corridor. Links to these services will be made through the Home Page operated by the New Jersey Highway Authority (NJHA) on the Internet.

1.2.4 Electronic Toll Collection and Traffic Management (ETTM)

NJHA customers will be able to use the E-ZPass system to pay their tolls electronically, and also for any fees at the park and ride facilities. This system will also be useable at other toll facilities in the New Jersey/New York metropolitan area and, eventually, at more distant toll facilities in the I-95 corridor. When fully operational with electronic violation enforcement, much of the traffic will proceed through the toll lanes without stopping. This will increase the effective capacity at the toll plazas and reduce delays to travelers.

1.2.5 Recurring Congestion

Recurring congestion occurs during commuting peaks whenever the volume of traffic trying to use a roadway segment exceeds the normal capacity of that segment. This condition also occurs during the summer when seasonal travel to the Jersey Shore creates unusually high traffic volumes particularly on Friday evenings and Sunday afternoons. Although ITS cannot increase the capacity of the roadway segments (until the implementation of reduced vehicle headways, made possible by the Automated Highway System), it can help reduce the traffic demand by advising travelers of existing travel times and delays, and alternate routes and modes. Although most travelers may not have any ability to shift their departure time, routes, or modes, the travelers that have this flexibility and exercise it should be able to minimize the recurring congestion-related delays. Pre-trip information would be made available to the traveler by the information service providers through radio, the Internet, and personal communication devices. En route information will be received through personal communication devices and in-vehicle systems.

1.2.6 Incident Management and Response

Incidents that occur in the Parkway Corridor will be handled safely, quickly and efficiently. Systems will be in place that identify when and where an incident has occurred, the equipment needed at the incident scene and then dispatching the appropriate response units that will remove the vehicle and associated debris from the travel lanes. Incidents will be detected by electronic systems, telephone calls to a number posted on the Parkway, and through the drivers of the NJHA vehicle fleet equipped with radios. At locations with

the highest frequency of incidents, the type of incident and the required response will be determined using CCTV systems. Tow trucks will also be positioned in areas with limited capacity and high accident frequencies to expedite the removal of disabled vehicles from the travel lanes. When there is a major incident the NJHA will inform drivers, transit operators, TRANSCOM, other highway operators in the corridor, and private sector information service providers. The response activities of agencies at major incidents will be coordinated using the Incident Command System and will make use of traffic management and diversion route plans developed with the cooperation of the emergency agencies and local communities.

1.2.7 Commercial Vehicles

Although trucks do not make up a major component of the travel on the Parkway, they are present south of milepost 105. These commercial vehicles are subject to periodic safety and credentials checks at an inspection station located in the Herbertsville area. In the future, these checks will focus on the units that have gone the longest without a safety inspection. Commercial vehicle operators with oversized vehicles will be able to apply and pay for a special permit with a single telephone call, and the required information will be automatically transmitted to the toll plazas and police posts through which vehicles will pass.

1.2.8 Facility Management

ITS systems will also allow the NJHA and other organizations in the corridor to improve the monitoring and maintenance of the roadway infrastructure. Accurate weather forecasts coupled with information on pavement temperatures and moisture conditions will enable the operators to apply anti-icing chemicals in the most cost-effective manner. GPS (global positioning system) and AVL (automatic vehicle location) systems will allow NJHA managers to identify the locations of the cars, trucks, and heavy equipment assets for which they are responsible. Using Computer Aided Dispatch (CAD) systems these managers will be able to identify the nearest and most appropriate unit to be dispatched when there is an incident on the highway, or the need for an emergency repair of a piece of equipment on the Parkway.

1.3 FOCUS OF THE REPORT

The remaining sections of this Strategic Deployment Plan identify how the New Jersey Highway Authority and other organizations will make this vision a reality.

The major focus of this report is the twelve projects that have been selected for short-term implementation. The materials that are presented in the following sections and the Appendices describe how these projects address the user needs in the corridor, and their costs and benefits. Supporting materials are included which describe how these projects

can be implemented and operated, how they work together within the framework of an overall System Architecture, and how this System Architecture fits into the regional architecture that is being implemented by TRANSCOM, and the National Architecture that is defined by the National ITS Architecture effort and the FHWA's Intelligent Transportation Initiative. Transportation professionals who want additional information on the topics contained in this report are referred to the bibliography which identifies the Technical Reports and other support documents that were prepared as part of this ITS Early Deployment Planning Study.

SECTION 2
THE PROJECTS

2.1 PLAN OVERVIEW

This early deployment plan is an important step in advancing the Garden State Parkway Corridor from its current state to the vision described in Section 1 of this report. Decisions on funding, manpower, technology advances, and institutional organization, and legal matters will need to be made before the complete vision is realized. Because of the approximately two-decade or longer time frame that would be expected to elapse before the concepts become reality, it is important to identify those things that could occur within the near-term, the next five years. At the same time, near-term improvements should be a means of advancing conditions toward the long-term objectives.

The twelve projects described in this section are only the first step in a larger program that extends even beyond the midterm projects described in the *Functional Requirements* report. These twelve projects were slated for "early deployment" because: 1) they respond to immediate needs within the corridor; 2) have the necessary precedent work completed; 3) entail costs that are within the abilities of current and near-term budgets; and 4) have the agreement and support of the appropriate agencies and organizations. All of these projects have been developed so that they can be initiated within the next five years. There has been no distinction made within that five-year time frame and subsequent programming will take over in determining the specific year in which appropriate planning, design, and construction funds will be appropriated.

This latter issue is important because the early deployment plan is not a separate budgeting process but rather part of the normal capital program budgeting that the New Jersey Highway Authority and other agencies associated with this plan must go through. These projects will next need to be included in the capital improvement plans of the responsible lead agencies, taking into account not only their priorities but also the priorities of the many other projects that have been identified for implementation during the same time frame.

Funding for the proposed projects and those that develop out of these recommendations should be expected from a variety of sources. There will be a partnership of existing public sector funds and private sector sources. Funds should be offered in a cooperative manner based on the following guiding principles:

- ITS projects offer genuine benefits to the travelers of the region. Transportation agencies are charged with providing service to these travelers

and so should view ITS as complementary means of delivering those services rather than as an additional burden. Use of existing budgets is consistent with this philosophy.

- ITS projects, when delivered on a region-wide basis, offer an economy of scale, thereby reducing the cost of delivering services to travelers. While increased service does incur increased cost, the increased cost comes at a discount to each constituent transportation provider—a win-win situation for both the transportation provider and user.

- ITS projects improve travel within the region and have a value. Travelers should, therefore, expect to pay for these projects. Additional funds, such as those derived from user fees, could come from traditional sources. Some examples of these sources may include gasoline, battery, tire excise taxes, and parking fees.

- ITS projects save money—for agencies that serve the public, for travelers, and for tax payers who generally pay the greatest share of the construction and operation costs of transportation improvements. The opportunity to spend money now to save money in the future suggests that it is in everyone's best interest to pursue this program of improvements.

- The proposed projects have the potential to increase the revenues of the participating agencies, public and private. Whether it is projects that enable the NJHA to charge parking fees at park and ride lots, or increase the attractiveness and, therefore, the ridership of transit lines, or the new mechanism for advertising a private enterprise through sponsorship of ITS projects, this program offers the potential to increase revenues.

- The private sector should be encouraged to participate in ITS projects but not expected to advance projects at the direction of government agencies. Projects that will make money will likely be assumed by the private sector. Just as private organizations have found a way to generate revenues through disseminating traffic information, other ITS projects will naturally be advanced if the private sector sees an opportunity. Public-private cooperation such that the private sector can participate, rather than be expected to operate alone, should be encouraged. Permitting the private sector a role as an adjunct, while funding the majority of the project through public sector funds, will continue to offer a net benefit to the region's travelers.

- At the core of this strategic deployment plan is an increase in safety. Safety is a principal concern of all transportation agencies and is clearly important to virtually everyone. The safety benefits that would accrue from this program speak strongly for universal support.

The projects included in this early deployment plan, therefore, should be viewed as means to accomplish the goals of the New Jersey Highway Authority and other transportation providers within the Parkway corridor. They are not additional or exceptional projects, requiring new or different funding sources. Consequently, these projects will compete with more traditional capital improvements for the funds of the NJHA and other transportation agencies.

The following projects listed in Table 2-1 are recommended for implementation over the next five years and should be advanced through the funding process. Descriptions of each of these projects are described in subsequent sections.

Table 2-1

PROJECTS RECOMMENDED FOR SHORT-TERM IMPLEMENTATION

PROJECT NAME
Upgrade the Parkway Traffic Operations Center
Traffic Monitoring with CCTV & Detector Systems
Establish a Parkway Home Page with Real-time Traveler Information
Expand VMS/HAR Systems
Process and Disseminate Real-time Travel Data
Advertise Emergency Assistance Phone Numbers with Highway Signs
Collect Travel Time Data in the Parkway Corridor
Operate a Bus Location System with ETTM Technology
Operate a Stop-on-Demand Bus Service Through Park & Ride Lots
Enhance Management of Park & Ride Lots with ETTM Technology
Display Real-time Transit Schedule Information at Park & Ride Lots
Operate Information Kiosks at the Service Areas (Private Sector)

2.2 PROJECTS RECOMMENDED FOR SHORT-TERM IMPLEMENTATION (0 TO 5 YEARS)

The following projects directly support seven of the market packages identified by the National ITS Architecture and FHWA's Intelligent Transportation Infrastructure Initiative.

2.2.1 Upgrade the Parkway Traffic Operations Center

Many of the other projects identified elsewhere in this plan require complementary improvements to the NJHA Communications Center. These projects would result in its evolution to a true Traffic Operations Center (TOC). The functional responsibilities of the enhanced TOC would include:

- processing the travel time data from E-ZPass tag readers,
- transmitting of the travel time and average speed data to TRANSCOM,
- updating static and dynamic data on the web page,
- dispatching assistance to disabled vehicles reported through the call-in system,
- monitoring activities at the park and ride lots,
- viewing the images on the CCTV monitors,
- posting appropriate messages on the HAR and VMS systems,
- exchanging data on accidents and incidents with other operators that may affect their agencies' operations, and
- processing and forwarding E-ZPass readings from buses to the bus operators.

The project would provide the building, software, hardware and other physical features needed for the efficient operation of the systems that are needed to fulfill these responsibilities.

2.2.2 Traffic Monitoring with CCTV & Detector Systems

This project would transmit improved information about traffic conditions on the Parkway to the NJHA Traffic Operations Center (TOC) personnel. CCTV systems would show the actual conditions at locations where accidents, incidents and other delays most frequently occur. Detector systems would measure traffic volumes at periodic intervals along the Parkway. The TOC personnel would use this information to help mobilize the resources to remove capacity constraints.

This project has two parts. The first is the installation of additional CCTV monitoring equipment at various locations along the Parkway. (Proposed CCTV locations are shown in Figure 2-1). These CCTV units would be installed in accordance with previously determined priorities. This first location would include the installation of the monitors at the NJHA's Traffic Operations Center. Follow-on projects would extend the camera coverage to areas with lower priorities.

The second part of the project would install detector systems for monitoring traffic flow on the Parkway. These detectors would be installed across all of the highway lanes at five to ten-mile intervals. The primary function of these detectors is to determine traffic flow volumes. Spot speeds would be estimated using detector occupancy rates and assumed vehicle lengths. The detector technology used for this system could be loop detectors, but might also be a non-invasive technology that is less expensive to install and maintain in heavy traffic volumes areas. Since the detectors would not be installed at closely spaced intervals, their placement is flexible, and can take advantage of existing overhead sign structures and overpasses.

(Note: The installation of E-ZPass readers at closer spacing would be used for the calculation of average travel times, average speeds and for incident detection between tag readers. The deployment of these tag readers is described in another project.)

2.2.3 Establish a Parkway Home Page with Real-time Traveler Information

This project would show traffic conditions to travelers before they begin their trips. Through maps showing average speed, and images from the CCTV cameras, travelers would be able to assess the best route, and departure time. The home page would also contain other information which can encourage travelers to use the Parkway, shift some trips to less congested time periods, and use the multi-modal facilities available in the Parkway corridor.

The home page on the Internet would present static and real-time information on traffic and travel on the Parkway. Static data would include information such as the best exits for popular destinations (Atlantic City, Great Adventure, Cape May beaches, etc.); locations of service plazas and the services available; locations of park and ride lots and the connecting bus services that are available from them. Separate sections of the web page would inform travelers on the use of E-ZPass tags, the commercial use of the Parkway, etc.

Real-time information would include data such as: the travel time or average speeds in major segments of the Parkway; locations of accidents and other traffic incidents; estimated delays at mainline toll plazas during peak periods or when there are major events at the arts center; and the occupancy of the park and ride lots and the estimated time that a lot would be full.

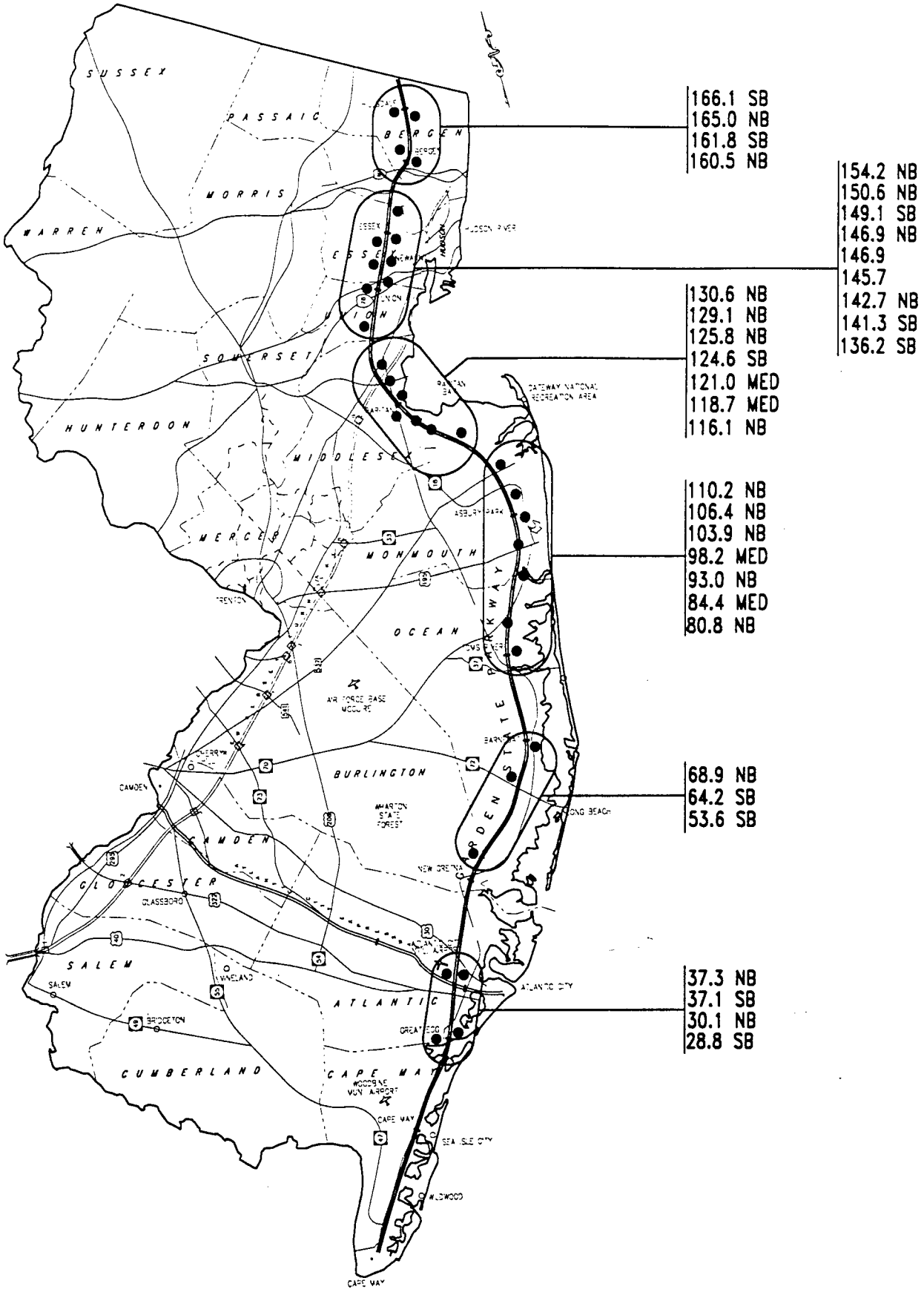


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Figure 2-1

Proposed CCTV Locations

2.2.4 Expand VMS/HAR Systems

This project would inform travelers of traffic conditions so that they could determine whether to stay on the Parkway or divert to an alternate route. The data describing traffic flow on the Parkway and alternate routes would be collected through other projects. This project would provide the devices that would be used to give this information to travelers on the Parkway, and travelers approaching the Parkway on major arterials.

The existing VMS and HAR systems in the Parkway corridor would be supplemented with additional units installed as part of this project. (See Figure 2-2). The project would determine the exact locations for these devices, and the supporting equipment required at the NJHA Traffic Operations Center.

2.2.5 Process and Disseminate Real-time Travel Data

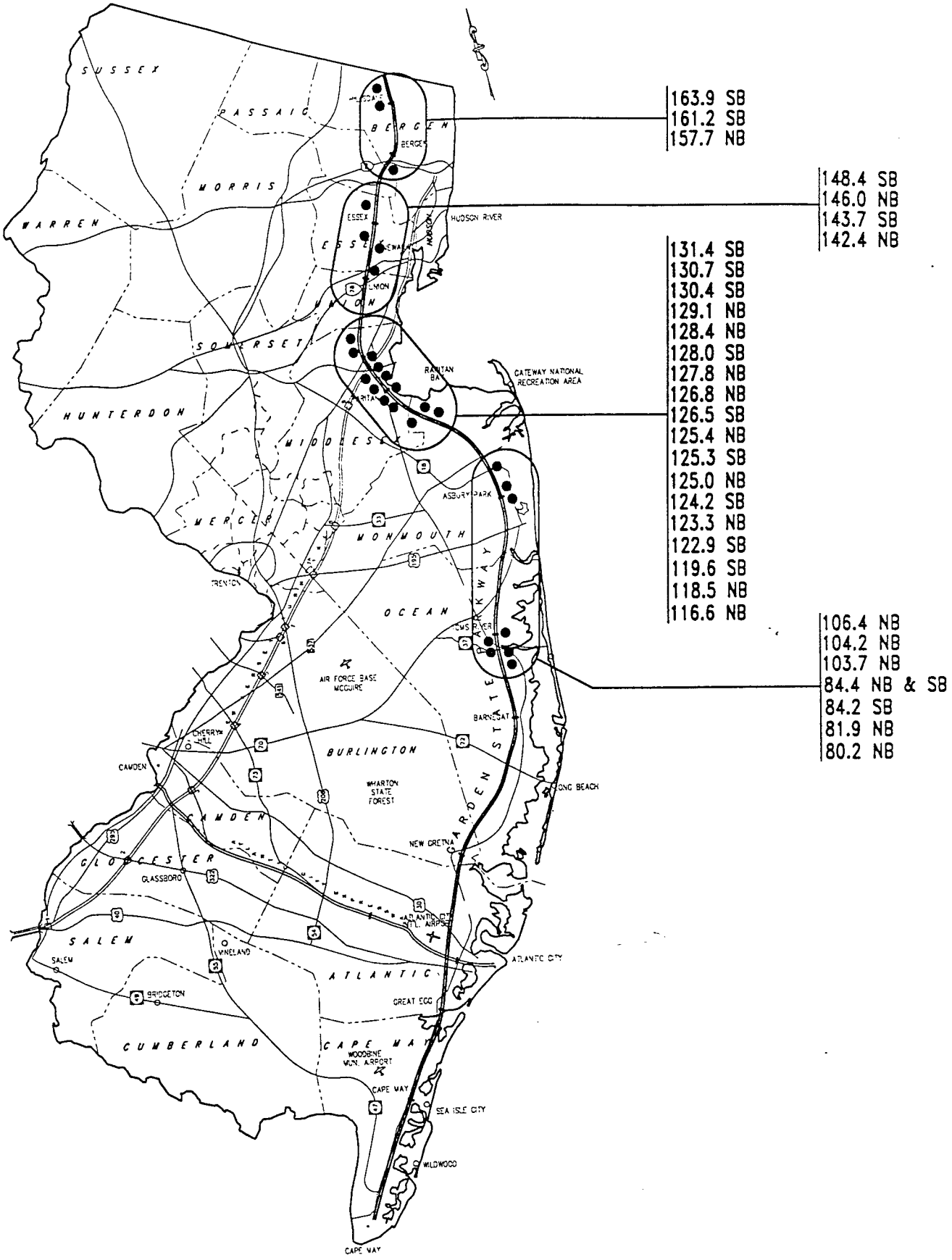
This project complements the deployment of the E-ZPass tag readers previously described by preparing estimates of the travel time and average speed that can be disseminated to the general public. The data would also allow motorists with more sophisticated in-vehicle equipment to determine their estimated travel times to specific destinations in the Parkway Corridor. The average travel time data would be disseminated through two ways. It would be transmitted to TRANSCOM where it would be combined with data from other agencies and disseminated to the public through the ISPs (information service providers) and other mechanisms. The average travel time data would also be converted to speed ranges and this information would be used to update a graphic display on the Parkway's web page. (The development of a home page for the Parkway is described in another project.)

2.2.6 Advertise Emergency Assistance Phone Numbers with Highway Signs

This project would let the public know how to report incidents and request assistance through the installation of static signs displaying the numbers to be called when there is an emergency, or a disabled vehicle. It would complement the systems that receive these calls, identify the location of the problem, and dispatch assistance. These signs would also reinforce the message to motorists that "You're Never Alone on the Parkway."

This project would resolve several issues including:

- selecting the telephone number to use for emergency calls,
- deciding which organization would answer the disabled vehicle calls,



HARRIS

Figure 2-2

Existing VMS Locations

- selecting the telephone number to use for disabled vehicles,
- obtaining agreements with the cellular telephone service providers to ensure that "good Samaritans" would not be billed for these calls,
- developing a design for these signs and their installation, and obtaining approvals from the agencies that are concerned, and
- developing guidelines for the locations at which these signs would be installed. (i.e., on the entrance ramps, a few hundred feet downstream of each on-ramp, or at periodic intervals on the mainline.)

The project would also be responsible for the design of any necessary enhancements to the telephone system and the physical facilities (such as desks, work areas, etc.) at the locations receiving these calls.

2.2.7 Collect Travel Time Data in the Parkway Corridor

This project would gather travel time data from individual vehicles equipped with E-ZPass tags and would use these data to estimate average travel times between tag readers. The NJHA's Traffic Operations Center personnel would use the raw travel time data to monitor traffic flow and detect possible incidents on the Parkway.

E-ZPass tag readers could also be installed on other roadways in the corridor. These tag readers would be installed in keeping with the priorities established by the NJDOT for its MAGIC program. Where appropriate, the data from these other readers could be carried back to the appropriate agency over the NJHA's fiber optic backbone, to the TOC, or another point where the NJHA's fiber can interface with an NJDOT communications hub.

This project would identify the specific locations where the tag readers would be installed, the design of the communications system, and identify the hardware and software required by this system in the field and at the TOC.

2.2.8 Operate a Bus Location System with ETTM Technology

Although NJ TRANSIT has tested a bus location system, it has no immediate plans to deploy such a system on their fleet. However, it is using E-ZPass tags to identify buses approaching the Port Authority Bus Terminal. The proposed project would utilize tags in a similar way to periodically identify the location of buses on the Garden State Parkway. The position of buses between reader positions can be approximated from the time the bus passed the upstream tag reader and the average speed of traffic between readers. With this knowledge, the bus operators can decide what actions to take when they receive requests for service at a park and ride lot not normally served (see the next project). The bus operators could also inform waiting passengers of long service delays resulting from bad weather or accidents.

This overall design for the system would be developed through the cooperative efforts of NJ TRANSIT, the NJHA, and the other transit operators in the corridor.

2.2.9 Operate a Stop-on-Demand Bus Service Through Park & Ride Lots

Bus operations and modal transfers can be encouraged and facilitated by making it possible for travelers to request bus service at park and ride areas. These bus services would be provided by bus routes that do not normally stop at the park and ride area, or routes that only stop at the park and ride area at other times of day. This project would develop a system for identifying when and where a bus patron has requested service, relaying this information to the appropriate bus service provider, communicating this request for service to the driver, receiving an acknowledgment of the request from the driver, and communicating the anticipated arrival time of the bus to the patron.

2.2.10 Enhance Management of Park & Ride Lots with ETTM Technology

The cost of new park and ride facilities and upgrades to the existing park and ride facilities and other ITS improvements would be offset through the collection of parking fees. In order to minimize the costs of this operation, the fees would be collected using the same E-ZPass tags that are used for toll collection. This project would implement the systems needed at the TOC for the monitoring of these facilities. This information would be used to change signing indicating that the lot is full on the roads leading to the lot. This system would also be used to collect tolls from drivers who enter or exit the Parkway through the Park and Ride lots.

2.2.11 Display Real-time Transit Schedule Information at Park & Ride Lots

The preceding projects lay the foundation for a system that would enhance customer confidence in the transit system by offering real time schedule information on bus arrivals at the park and ride lots.

The information displayed at the park and ride lots would include the names or numbers of the bus routes serving that lot and the estimated arrival time of the next bus on each route. This system design must be flexible enough to accommodate information from multiple transit operators serving the same facility, and may also be part of the interface for the passengers who request service from a bus that would not otherwise stop at that location. (See the project description for "Operate a Stop-on-Demand Bus Service Through Park & Ride Lots.")

2.2.12 Operate Information Kiosks at the Service Areas (Private Sector)

TRANSCOM, through its Service Area Travel Information Network (SATIN) project, is currently developing a system for the dissemination of data through information kiosks.

This project would support these and other efforts to put useful information at the finger tips of travelers on the Parkway through additional information kiosks at the service areas and park and ride areas. It is anticipated that this information would allow travelers to: make advance room reservations; buy tickets for activities at the PNC Bank Arts Center and other venues; get detailed directions to Atlantic City casinos and other destinations of their choosing; and obtain other travel related services. The involvement of the private sector is an essential part of the deployment of ITS services.

2.3 PROJECT RESPONSIVENESS TO PROJECT GOALS AND USER NEEDS

This early deployment project was organized around a series of goals for the Garden State Parkway Corridor. Under the direction of the project Steering Committee, the project team formulated a "vision" for the corridor that was summarized into five specific goals. These are:

- improve service levels (and efficiency);
- improve safety;
- improve mobility;
- reduce energy and environmental impact; and
- enhance productivity.

In relative terms, the Steering Committee assigned the greatest importance to the first two of these goals and therefore indicated that projects that evolve from this work should, above all else, improve service levels and safety within the Corridor. These goals were forward-looking, taking the situation today and projecting the desires for the future.

The entire ITS planning process is built around the concept of responding to user needs. In the Garden State Parkway Corridor these user needs were identified through an extensive outreach effort. As reported in other project documents, this effort included numerous meetings and discussions with a wide variety of "stakeholders," including representatives of government agencies and transportation providers, as well as discussions with representatives of private and quasi-public organizations. Table 2-2 shows the stakeholders that were contacted as part of this outreach effort. Surveys of travelers and workers in the Parkway corridor were also performed, and these results were compared with the surveys conducted by the I-95 Corridor Coalition. These initial activities culminated in the generation of a series of statements of ITS related needs.

The Steering Committee and project team also evaluated the transportation needs within the study corridor. The needs were categorized under the general headings of:

- signals;
- information;
- coordination;

- transit; and
- other.

Table 2-3 summarizes the specific needs that were identified early in the project. It was also, therefore, implicit that any improvements developed for the Parkway Corridor respond to the transportation needs that exist today and will persist into the future absent specific actions.

Table 2-2

TRANSPORTATION STAKEHOLDERS CONTACTED

Sector	Organizations	
Counties	Cape May County * Atlantic County * Ocean County * Monmouth County * Middlesex County *	Union County * Essex County * Passaic County * Bergen County
Cities	Atlantic City *	City of Newark *
State Agencies and Organizations	New Jersey Highway Authority * New Jersey State Police * New Jersey Turnpike Authority * New Jersey Department of Transportation *	NJ TRANSIT * New York State Thruway Authority * Port Authority of New York and New Jersey South Jersey Transportation Authority*
Regional Organizations	TRANSCOM * South Jersey Transportation Planning Organization	North Jersey Transportation Planning Authority
Transportation Management Associations	Cross County Connection Hudson TMA Keep Middlesex Moving *	Meadowlink * Morris County Rides * Transit Plus of Essex & Union *
Advocacy Organizations	American Automobile Association * Bloomfield Chamber of Commerce Casino Association of New Jersey Coalition of New Jersey Cyclists Environmental Defense Fund Hackensack Meadowlands Development Commission * League of Women Voters MSM Regional Council National Motorists Association - New Jersey * New Jersey Future New Jersey Sports & Exposition Authority *	NJ Alliance for Action NJ Business & Industry Association NJ Chamber of Commerce NJ Conservation Foundation NJ Environmental Lobby * NJPIRG Paramus Chamber of Commerce Regional Business Partnership South Jersey Development Council The Atlantic Group Tri-State Transportation Campaign Woodbridge Chamber of Commerce *
Colleges	Bloomfield College Brookdale Community College Fairleigh Dickinson University Kean College * Montclair State College Monmouth University	New Jersey Institute of Technology Ocean County College Ramapo College * Rutgers University Seton Hall University Stockton State College

* Provided comments and/or materials as part of outreach effort.

Table 2-2

TRANSPORTATION STAKEHOLDERS CONTACTED (Continued)

Sector	Organizations	
Tourist Organizations	Atlantic City Race Track Barnegat Lighthouse Cape May Chamber of Commerce Gateway National Park Recreation (Sandy Hook) *	Host Marriott Services * Monmouth Park New Jersey Department of Tourism Six Flags Great Adventure
Bus Operators	Academy Bus Community Bus Lines * Helfrich Bus Murphy Bus Olympia Trails Bus Company	Red & Tan Lines, Inc. * Saddleriver Tours Shortline Bus Suburban * Shamrock Stage Coach *
Employers	Aegis Property Group Allied Outdoor Advertising, Inc. A&P Atlantic Electric Company AT&T * Bell Atlantic Benjamin Moore B.M.W. Carnegie Center Association Fort Monmouth Hertz Hovnanian Enterprise Ingersoll Rand Corp. Johnson & Johnson	KPMG Inc. Larson Financial Resources Marriott Corp. Merck & Co., Inc. Oyster Creek Nuclear Power Plant * Powell Capital Markets, Inc. Price, Sneirson, Shulman & Meese Progresso Foods Prudential Insurance PSE&G Sony Corp. Volvo Car Finance Whitfield, Barrister & Brown
Hospitals	Atlantic City Medical Center Bayshore Community Hospital Bergen Pines County Hospital * Burdette Tomlin Memorial Hospital Community Memorial Hospital East Orange General Hospital Irvington General Hospital Jersey Shore Medical Center Muhlenberg Regional Medical Center	Robert Wood Johnson, Jr. University Hospital Roosevelt Hospital Shore Memorial Hospital St. Joseph's Hospital & Medical Center Union Hospital University Hospital
Limousine Services	Airbrook Limousine Airport Limousine Express * Atlantic Limousine Claridge Casino Limousine Service Enchantments Limousine Harrahs Casino Hotel	Johnathan's Limousine Newark International Airport Olympic Limousine Service * Sands Limousine * Trop World Limousine

* Provided comments and/or materials as part of outreach effort.

Table 2-3

TRANSPORTATION NEEDS WITHIN THE PARKWAY CORRIDOR

Need Statement
SIGNALS
NJHA-controlled traffic signals need improvement and should be coordinated with other roadway signals.
Signalization on roadways should be improved.
INFORMATION
Information (video and data) on congestion and accidents should be shared more quickly with local agencies.
There should be more VMS's giving motorists information.
The timeliness and accuracy of traveler information should be improved.
Better signage to the Parkway is needed at incomplete interchanges.
Incident detection and verification should be improved.
COORDINATION
Operational coordination between the Garden State Parkway, New Jersey Turnpike and NJDOT's Magic system should be improved.
Southeastern New Jersey needs its own TRANSCOM.
Diversion route planning and incident response should be coordinated with local communities.
ITS planning should be coordinated with local agencies.
TRANSIT
Transit companies want reduced delays at toll plazas.
Bus drivers should know of people waiting at park & ride lots.
The speeds of buses traveling too fast should be reduced.
NJ TRANSIT wants information on the location of their buses, electronic fare collection, and surveillance at major transit stops.
The Garden State Parkway bus diversion project should be expanded.
There should be HOV lanes for buses.
OTHER
Park & ride lots should be expanded and ride sharing made easier.
Parkway entrances through park & ride lots pose a circulation, safety, and revenue problem.
Congestion and delays are a problem at toll booths and some mainline segments.
Improve the capability and visibility of the motorist assistance program.
Credential and safety checks for buses and trucks should be facilitated.

Early in the study, the project team decided to try and address these needs through one or more of the 53 user service market packages, identified and defined by the National ITS Architecture. User Service Market Packages are the basic building blocks for implementing ITS services. The concept offers a service-oriented perspective rather than

a project-specific definition. A User Service describes the nature of the improvement that is desired—information on roadway conditions over the next hill—rather than the project-specific—a variable message sign. The ITS planning process moves from generalized services to specific actions that will supply those services. Market Packages are the components that together can deliver the desired user service. Again, these are general and service-oriented rather than project specific. The Market Package "Network Surveillance," for example, would include a means of observing activity on the roadway, a means of transmitting that information to a place where it can be received and processed, and the receiving and processing location. When this User Service Market Package is fully developed, the project that emerges could well be roadside cameras, connected by fiber optic cable, transmitted to a traffic operations center.

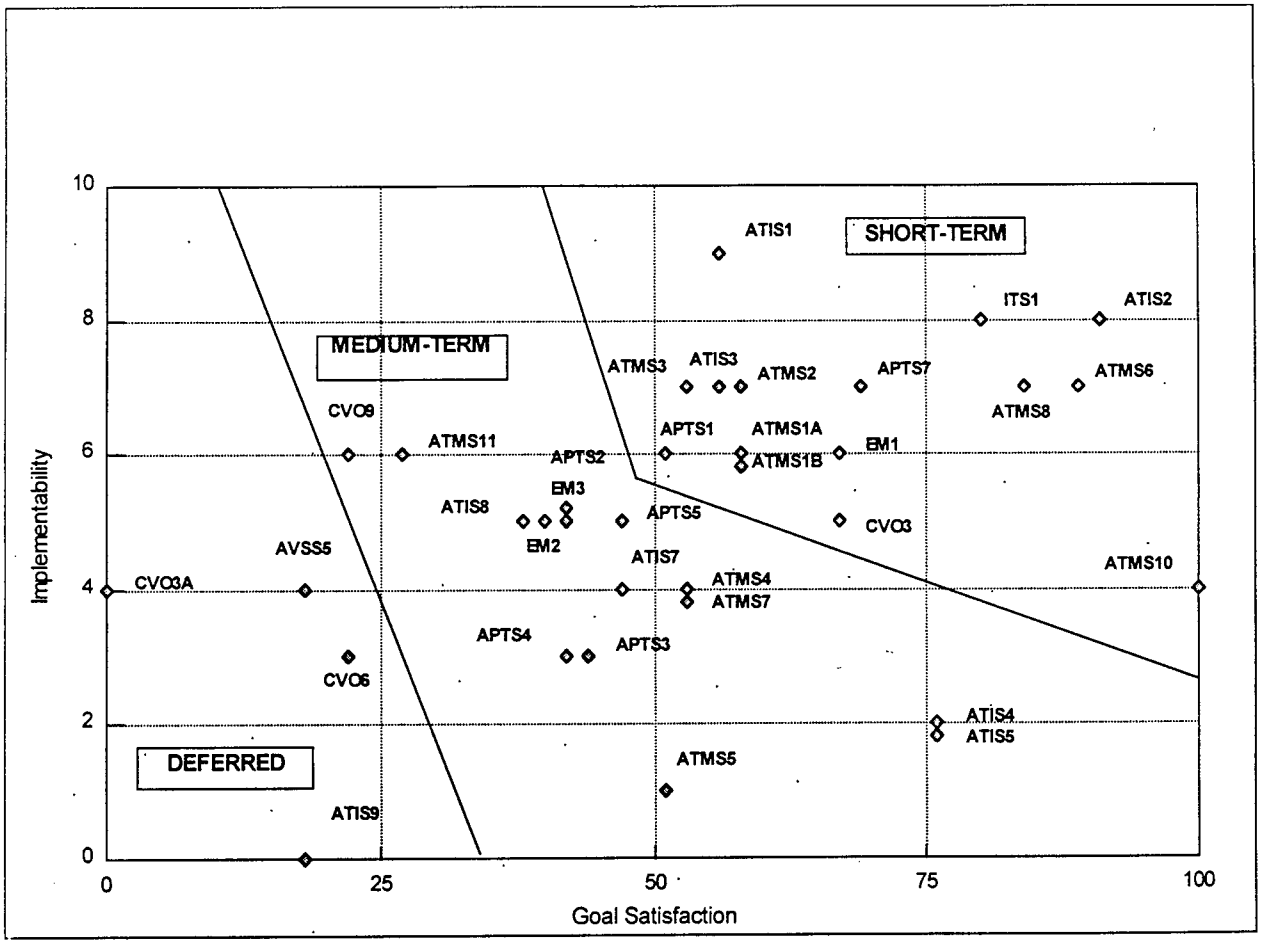
The User Service Market Package concept recognizes that each Package can deliver part or all of more than one user service and respond to one or more needs for a project study area. A traffic operations center cannot only receive video images from roadside cameras but also dispatch emergency vehicles, for example, to respond to incidents. Having invested in the Network Surveillance User Service Market Package as the camera system described above, it would likely be more efficient to develop other projects that capitalize on the fiber optic cable and traffic operations center than to construct a parallel arrangement for other desired User Services.

The User Service Market Packages advanced for this study respond directly to the goals of the project and the needs of the corridor. Each of the 53 User Service Market Packages was evaluated for their responsiveness to the goals and needs. A further discriminator in preparing the final list of projects was the time frame in which they could be reasonably implemented. Some projects are dependent on actions being taken prior to their implementation. These dependencies could dictate a schedule for implementation. Funding, institutional barriers, advances in technology, and other preconditions could also suggest that some projects could be implemented immediately while others would need to wait beyond the five-year time frame established for early deployment.

The resulting list of twelve projects, which evolved from the User Service Market Packages meeting the goals and needs of the project and that could be implemented within the next five years, is included as the final recommendations for this study. The "mapping" of the short-term, medium-term and deferred term User Service Market Packages with respect to Goal Satisfaction and Implementability is shown in Figure 2-3.

Figure 2-3

MAPPING OF USER SERVICE MARKET PACKAGES INTO IMPLEMENTATION TIME FRAMES



2.4 PROJECT COSTS

The projects generated by this Early Deployment Study are still only in the concept stage. Assumptions had to be made regarding the general characteristics, technology, and anticipated operations for each of the projects. Generally, the physical characteristics of the projects have not been well defined. Instead, they derive from a series of functional requirements and assumptions as to the means of meeting those requirements. An assessment of existing infra-structure, physical characteristics of the equipment and the sites in which the equipment will be placed, and other factors will follow this work.

2.4.1 General Assumptions

It was determined that a total of 18 to 24 people would be needed to facilitate day to day operation of all of the proposed projects. The time and cost of each employee is detailed in each of the individual projects under the "Operations" line item cost. This cost incorporates fringe benefits and a percentage of the overall Traffic Operations Center overhead costs. In most cases an employee would not be needed full time to operate and maintain an individual project. Consideration of this was made, with the operator's time being split between projects accordingly. Moreover, economies of scale are also possible by utilizing existing NJHA staff to perform some of the functions in the new Traffic Control Center.

2.4.2 Communications

Because the time frame for implementation of the ETC-FOC backbone in New Jersey is still somewhat unsettled, an attempt was made to determine an average cost for the communications "tie-in" of each piece of equipment. This average tie-in cost was determined to be somewhere in the neighborhood of $12,500. This cost would include all needed materials and labor to successfully tie each piece of equipment, from its static location, into the existing fiber optic back bone.

This estimate is towards the higher end of costs that might be incurred, with significant reductions for communications tie-ins possible. Actual costs depend on several variables, such as final equipment locations and type of tie-ins necessary, which will be determined at a later date.

With this level of conceptual engineering, therefore, an accurate engineering cost estimate is not possible. Nevertheless, by making some assumptions and looking at the range of costs from similar systems in other locales, it is possible to develop a "first estimate" of the magnitude of the project costs. This cost estimate should serve both as a guide to the anticipated project and also a preliminary definition of the details of each of the twelve recommended projects.

Table 2-4 lists the projects recommended for early deployment and a cost range that can be anticipated for their construction and implementation. Judgement is required, and depending upon the individual case, the higher, or lower cost may be the most appropriate one to use for future discussions. The assumptions that were used to develop these cost estimates along with the details of the estimate are included in Appendix A of this report.

Table 2-4

PROJECT COST ESTIMATE SUMMARY

PROJECT IDENTIFICATION		COST/ (RANGE)
Traffic Monitoring with CCTV & Detector Systems	CCTV DETECTORS	$1,711,000 - $2,554,000 $1,238,000 - $1,840,000
Advertise Emergency Assistance Phone Numbers with Highway Signs		$76,000 - $126,000
Collect Travel Time Data in the Parkway Corridor		$4,118,000 - $7,185,000
Process and Disseminate Real-time Travel Data		$120,000 - $225,000
Expand VMS/HAR Systems	VMS HAR	$2,283,000- $4,188,000 $640,000 - $1,175,000
Establish a Parkway Home Page with Real-time Traveler Information		$37,000 - $67,000
Upgrade the Parkway Traffic Operations Center		$1,808,000 - $2,329,000
Enhance Management of Park & Ride Lots with ETTM Technology		$305,000 - $688,000
Operate a Bus Location System with ETTM Technology		$32,000 - $115,000
Operate a Stop-on-Demand Bus Service Through Park & Ride Lots		$324,000 - $403,000
Display Real-time Transit Schedule Information at Park & Ride Lots		$1,000,000 - $1,397,000
Operate Information Kiosks at the Service Areas (Private Sector)		$583,000 - $1,266,000

* All cost estimates include Total Construction Cost, and Operations & Maintenance costs for one year
* Design costs are not included in this table

2.5 PROJECT BENEFITS

Each of the short-term projects will produce benefits that will accrue to motorists and of the travelers, the various transportation agencies, and the general public. Many methods have been developed for quantifying these benefits and ultimately converting those benefits to a specific monetary value. This was not done here because of the as yet conceptual nature of the projects and substantial amount of data required to produce such an assessment. Furthermore, such assessments frequently become highly subjective, when for example, the value of time and of human lives are reduced to monetary terms.

Instead, each of the projects was reviewed to determine the array of potential benefits that would derive from them. Benefits were first characterized in two different ways, direct and indirect. Direct benefits were those that would clearly emit from implementation of the specific project and could, under ideal circumstances be quantified in some fashion, even if the specific methodology for that quantification might be complicated. Reductions in delay, at least in principal, could be measured by determining travel speeds before and after the implementation of a project. Using computer models, actual field measurements, or other means, it would be possible to quantify and note reductions in delay and ascribe those delays to the installation of a project.

Indirect benefits are somewhat less clear both in ability to measure and to whom they accrue. Many of the projects produce planning data which are useful to transportation planning agencies and ultimately to the general public. There are no easy measures, however, of how much data are produced nor how valuable those data are. It is also unlikely that one would undertake a project simply for the indirect benefits. The indirect benefits are therefore shown separately from the direct benefits.

A review of the benefit would also show that some projects produce more than one benefit but that some of those benefits are relatively minor. Minor benefits were defined as those benefits that derive specifically from the project but are secondary in magnitude to the major benefits. CCTV, for example, when used in conjunction with other equipment, has the potential to reduce delay on the Parkway by assisting in detecting incidents and enabling a rapid response, and disseminating a warning to travelers. Secondarily, the ability to clear an incident sooner would reduce the time an injured person is without medical attention and the time period during which subsequent accidents by passing traffic might occur. This increase in safety has been defined as a minor benefit of the CCTV project.

The range of benefits also assists in defining the geographic scope and extent of the proposed projects. Again, CCTV will reduce delay but only if coverage is sufficient to view enough of the areas in which incidents frequently occur. Table 2-5 summarizes the benefits of each of the twelve recommended projects. Appendix A contains a more thorough discussion of the benefits for each of the projects.

TABLE 2-5
BENEFITS OF IMPROVEMENT PROJECTS IN THE PARKWAY CORRIDOR

PROJECTS	DIRECT BENEFITS											INDIRECT BENEFITS			
1. Install CCTV & Detector Systems	●		○	○							○	●	○		
2. Install Signs with Phone Numbers for Emergency Assistance and Reporting of Disabled Vehicles	●		●							●			○		
3. Extend TRANSMIT Surveillance on the Parkway & Other Roadways to Collect Travel Time Data	●	○	○								○	●	○		
4. Process and Disseminate Real-time Travel Time Data	○	○								●	●		○	○	
5. Install Additional VMS/HAR Systems on the GSP and Key Arterials	●		○							●			○		
6. Establish a Parkway Home Page with Real-time Information		○			○		○				●	○		○	○
7. Upgrade the Parkway Traffic Operations Center	●	○	●					○	○			○			●
8. Enhance Management of Park & Ride Lots with ETTM Technology					●	○	○			●	○	○	○		○

PROJECTS															
9. Operate a Bus Location System with ETTM Technology				○			○	●	○			○			
10. Operate a Stop-on-Demand Bus Service Through Park & Ride Lots				●	○	○	●		○	●	○		○		●
11. Display Real-time Transit Schedule Information at Park & Ride Lots					○	○	●			●	○		○		●
12. Operate Information Kiosks at the Service Areas (Private Sector)										●			○		○

● = Major Benefit
○ = Minor Benefit

SECTION 3
IMPLEMENTATION AND OPERATIONS FRAMEWORK

The distribution of this strategic deployment plan concludes the concept planning for short and mid-term intelligent transportation system improvement in the Garden State Parkway Corridor. The list of projects in the preceding section responds to the immediate and projected needs of the corridor, are feasible for implementation within the designated time frames, and will assist the NJHA in achieving its vision for the Parkway and for an ITS program. Other projects have been identified for implementation in the mid-term, the five to ten-year time frame following this initial round. Those projects will build upon the initial list and will, in some cases, require more resources than can be brought together in the next five years.

This plan also indicates a direction for improvements beyond the ten-year horizon. The vision for the Garden State Parkway Corridor, described in Section 1, will require installing and operating projects that transcend the short and mid-term because of funding constraints, the need to establish a record of success, and prerequisite for creating an appropriate institutional framework in which to carry out corridor-wide improvements.

This section of the report describes the steps that will now need to be taken to implement the recommended improvements for the short-term. Many of these ideas will also aid in advancing the mid and long-term projects as well.

3.1 PROGRAM MANAGEMENT

The Strategic Deployment Plan should be submitted to the Engineering Committee and the Authority's Board of Commissioners for their endorsement and acceptance. By endorsing the plan, the Board would indicate that it concurs with the findings and recommendations and is prepared to support the plan's further development and implementation. At this stage, the endorsement would signify support for developing the current list of projects from their general project statements into a specific list of hardware, software, and policy recommendations where appropriate, construction plans, specifications and estimates will be prepared for bids. Costs would be refined and funding sources identified. Discussions would be initiated with those agencies and entities that would be required to cooperate with NJHA in advancing these projects.

The twelve projects in this Strategic Deployment Plan will require a program advocate. The advocate should be someone at a senior level to be able to seek the assistance and cooperation from within the Authority to gain the planning, engineering, construction, operations, and maintenance support to advance the recommended projects through their

operations, and maintenance support to advance the recommended projects through their planning and preliminary design. The individual identified as the plan advocate should be familiar both with the plan's formulation and the details of the ITS improvements that it contains. The plan advocate should also work at a level that permits sufficient time to deal with the details of the plan and its components. He or she would presumably be responsible for developing a concise description of the plan, creating a presentation of the plan's content for the Board of Commissioners and other decision-making groups, and be able to make modifications and revisions to the plan to respond to evolving issues and concerns.

Each individual project will need a project sponsor, someone under whom the projects will be refined and better defined. Not all of the sponsors will be employees of NJHA. The following table (Table 3-1), lists the responsible agencies for each of the recommended short-term projects. NJHA will need to take a lead role in developing eight of the twelve projects and will have an important supporting role in four. A specific individual, by name or by position, will need to be assigned within the sponsoring or supporting agency.

Table 3-1

PROJECTS RECOMMENDED FOR SHORT-TERM IMPLEMENTATION

PROJECT NAME	PROJECT SPONSOR	PROJECT CO-SPONSOR(S)
Traffic Monitoring with CCTV & Detector Systems	NJHA	NJDOT
Advertise Emergency Assistance Phone Numbers with Highway Signs	NJHA	Agencies charged with responding to distress calls, cellular telephone companies, NJDOT
Collect Travel Time Data in the Parkway Corridor	NJHA	NJDOT TRANSCOM
Process and Disseminate Real-time Travel Data	NJHA	TRANSCOM, ISPs*
Expand VMS/HAR Systems	NJHA	NJDOT
Establish a Parkway Home Page with Real-time Traveler Information	NJHA	ISPs
Upgrade the Parkway Traffic Operations Center	NJHA	TRANSCOM, NJDOT
Enhance Management of Park & Ride Lots with ETTM Technology	NJHA	None identified
Operate a Bus Location System with ETTM Technology	NJTRANSIT	NJHA and other bus operators
Operate a Stop-on-Demand Bus Service Through Park & Ride Lots	NJTRANSIT	NJHA and other bus operators
Display Real-time Transit Schedule Information at Park & Ride Lots	NJTRANSIT	NJHA and other bus operators
Operate Information Kiosks at the Service Areas (Private Sector)	TRANSCOM	NJHA, private sector participants

* ISP: Information Service Provider

The program advocate will need to work with the project sponsors, including those outside of NJHA, to present a unified front and advance a concerted effort to implement these projects. Good communication will be important to ensure that the projects advance consistently within all affected agencies. Periodic meetings and frequent informal

communications should take place throughout project planning, design, and implementation.

An important coordinating element in all transportation projects is the Metropolitan Planning Organization (MPO). In New Jersey, there are two MPOs with responsibility for urbanized areas within the northern and southern sections of the state. The northern MPO is the North Jersey Transportation Planning Authority; the southern MPO is the South Jersey Transportation Planning Organization. All transportation projects should be included on the MPOs' transportation improvement plan (TIP) and any project using federal or state funds must appear on this list. For this reason, the program manager must work with the appropriate officials at the MPOs to see that the early deployment projects are advanced along with other general transportation projects.

3.2 CAPITAL PROJECTS PROGRAMMING

Projects relying upon NJHA funds must, in addition to the MPO programming requirements, comply with internal requirements. The New Jersey Highway Authority plans, designs, and constructs projects under the guidance of a five-year capital improvements program. The current program was initially developed to cover the years 1990 through 1995 and was to coincide with the last toll increase and with the issuance of bonds for capital improvements. Because of a subsequent bond issue, the term of the program was extended through 1998 and the total amount funded was increased from $280 million to nearly $325 million.

Each year, an annual plan is developed from the five-year plan. Projects are included in the annual plan based upon bonding, revenues, and project requirements. Any project must be included on the five-year plan before planning, design, or implementation can begin. The projects are carried through a development, review, and selection process both to reach the five-year plan and to be included in a specific annual plan. The ITS projects recommended in this early deployment study, therefore, will need to be developed to the same level of specificity as "conventional" projects and will receive the same scrutiny as such projects.

Each project will be described and its needs documented. The material in the *Projects* section of this report will provide much of the information needed to formulate a full project description and justification. Further project development will undoubtably be required. Each of these projects will be submitted to the Future Planning Committee, a group consisting of the NJHA Executive Director and Deputy Director, the Chief Engineer, the Comptroller, and the Director of Financial Planning. The Deputy Chief Engineer, Director of Tolls, and Director of Maintenance serve as advisors to the Future Planning Committee.

The Committee considers the sources of capital funding, both within the NJHA and outside. The needs, costs, and funding sources can therefore be assessed and a "short-list" of projects developed. A ranking of the projects is established using a system with several categories of funding. Within each of the categories, priorities are established so that funding is distributed between them. The first category is urgent safety projects, those that respond to immediate needs involving traveler safety. This is followed by system preservation and safety, an upgrading and maintaining of the transportation system. Congestion mitigation is the third category and frequently includes those projects that come under the broad heading of ITS. New capacity projects, roadway widenings, and other projects comprise the other categories.

Projects are further ordered to achieve a balance between NJHA departments and geographically across the state. The Future Planning Committee reviews the short list and develops a plan for the Engineering Committee. This committee, consisting of the Deputy Executive and Chief Engineer review and confirm the list before forwarding it to the full board of directors of the NJHA.

The Five-Year Capital Program schedules all phases of a project—planning, environmental studies, design, and construction. Once a project is included on the Program, NJHA staff then develops detailed scopes for the projects and implement the plan in accordance with the program and availability of funds. NJHA has for the first time recently sought federal money through the New Jersey Department of Transportation. This study is a product of that request. Because this money is often difficult to obtain and comes with many legal requirements, such funding is not counted on but does extend the Authority's ability to make improvements. Funding is also obtained through partnership agreements with localities. This arrangement has been successfully employed to obtain highway advisory radio in parts of the corridor, as an example.

The projects recommended in this plan for immediate implementation will need to be included in this programming sequence immediately, to become funded and implemented. The projects are formulated starting in August and so this plan may be somewhat behind others currently going into the next annual review of the Five-Year Capital Improvement Program. This should not deter staff from commencing on an accelerated schedule to bring these projects to a level of specificity equal to other, non-ITS projects. Simultaneously, project sponsors should seek opportunities for joint funding between NJHA and other state and local entities. Projects carrying some independent funding may be advanced ahead of those for which only NJHA funding is available. Similarly, some ITS projects may be ideal candidates for federal funds. Because of the nature of ITS projects, federal environmental and contracting requirements may be less restrictive than those associated with widening and improvements on new location. They may also be eligible

for additional funding sources such as Congestion Mitigation and Air Quality (CMAQ) Funds.

Projects with a longer implementation time-frame will also need to be included in the programming sequence. The longer lead time on those projects offers opportunities to better incorporate the program of improvements into the larger scheme of transportation improvements.

3.3 PROGRAM MONITORING

The ITS program will need monitoring, both as it moves toward implementation, and afterward, as it is put into action. Responsibility for the overall program and the individual components may move from one individual or office to another but continuous oversight is essential. Continuous oversight through the implementation phase will ensure that the projects are constructed.

During the next five years, internal and external factors may interfere with the advancement of these projects. Because many projects are unconventional, as compared with improvement projects completed in say, the last five years, it is important that these projects are shepherded through the design and construction process. Their successful implementation will make future ITS improvements easier to accomplish and increase the possibility that projects implemented over the short-term and mid-term market packages will ultimately be realized.

Following construction, monitoring will also be required to fine-tune the projects to maximize their benefits. Performance criteria, developed earlier in this study, will assist in periodic evaluations of the effectiveness of the projects. The anticipated benefits of these projects have been identified. The ongoing monitoring will confirm that those benefits are realized. It will also enable modifications of the projects, such as expanding the geographic coverage or hours of operation, to optimize those benefits. Monitoring may also reveal unintended impacts of these projects. Such impacts might dictate changes in the original project in the form of additions, revisions, or deletions.

The program advocate assigned at the conclusion of this early deployment study should be designated to remain with the program through final construction. The program advocate would follow the activity of each project, both with NJHA and in other agencies and oversee the work of the project managers through each phase leading to implementation. Coordination between agencies, between departments within NJHA, and between project staff and outside vendors and utilities, would be the responsibility of the program advocate.

The individual projects will be monitored by the project managers. Typically, projects are assigned to an individual for only part of the design and implementation process. Once a project has been fully developed in a planning and programming department, it is frequently passed to a design manager who oversees the preparation of contract plans. The contract plans are forwarded to a construction department where the contract is let and the construction work monitored. Final implementation and testing are typically included within this final category. System operations are then directed by an operations department and maintenance covered by a maintenance department. The divided responsibility of the project permits use of the most qualified staff, the individuals with the necessary skills to plan, fund, design, build, and operate a project to take charge of the appropriate phase of the work.

The principal shortcoming of such an arrangement is the lack of continuity between phases. The designated program advocate would be able to bridge those gaps, ensuring that the project does advance from one phase to another and that a project manager is assigned quickly. The program advocate concept should overcome the weakness of divided responsibility for the individual projects while still capitalizing on the skills of the best project managers.

Following implementation, the projects will generally cease to have individual identities and become part of a larger system. Responsibility for their operation and their success will evolve to the existing and proposed staff that handle such matters. Overall program monitoring using the performance criteria established in this study can still reside with the program advocate. He will require the assistance of a variety of agencies and individuals to obtain and process performance data. However, the effort expended will assist the ITS program as it will permit the program advocate to develop a track record that will help to sell the next series of projects. The program advocate, therefore, is an important participant in the ultimate success of this program.

SECTION 4
IMPLEMENTATION FRAMEWORK

This early deployment plan exists within the context of an ongoing program of transportation improvements which includes both ITS and conventional features. Since its inception, the New Jersey Highway Authority has pursued a program of offering a transportation system that would facilitate the movement of goods and people within and through the State of New Jersey. Even within the context of ITS, the NJHA has implemented ITS projects, even before the term ITS entered into common usage.

The projects described in Section 3 of this report are a part of a larger program of ITS improvements. They would be implemented as but the next step in a long progression of transportation improvements, complementing those features already in place and paving the way for additional components in the future. They respond to needs that have not yet been met with existing ITS components. They also represent reasonable objectives for installation within the next five years or so. The following paragraphs describe the broader ITS program for the Garden State Parkway Corridor—those projects that are currently in place, those that are in the "pipeline" for implementation, and those that are still required based upon the unfulfilled needs expressed by the Steering Committee that participated in the preparation of this plan.

4.1 PREVIOUSLY PROGRAMMED AND ONGOING NJHA ITS INITIATIVES

The NJHA and other agencies with transportation-related responsibilities have installed a significant amount of ITS equipment both on the Garden State Parkway and within the GSP corridor. The existing ITS infrastructure includes variable message signs and CCTV cameras (principally near the Driscoll Bridge). The NJHA has also strongly supported intermodal activities by constructing park and ride areas, formulating service arrangements with transit operators in the corridor, and establishing the Montvale Transportation Center which provides airline ticketing and limousine service to the region's airports. NJHA has worked with transit operators to implement an "alternate bus routing" project to help bus drivers select the least congested roadway in the vicinity of the Driscoll Bridge.

Although the list of ITS features within the project corridor is constantly growing, the principal traffic management assets are described in the following paragraphs.

- **Variable Message Signs**. The Authority was among the first transportation agencies in the state to deploy over-the-road, flip-disk variable message signs.

- **Vehicle Sensors**. The Authority has installed loop detectors and associated equipment along an eight-mile stretch of the Parkway, where no tolls are collected, for traffic flow monitoring and incident detection. The section extends from the point where the Parkway crosses the New Jersey Turnpike at Turnpike exit 11 to a point south of Union.

- **Ducts for Fiber Optic Cable**. The Authority installed a bank of six cable ducts between the Raritan and Union toll plazas some of which could be used for ITS communication, as well as other communication. (See Figure 4-1). The Authority also has the right to use duct banks installed along the Parkway by various private sector communication companies. In conjunction with a statewide communication master plan, the communication company ducts available for the Authority's use were mapped, and opportunities to use these ducts in a shared communication network were identified.

- **Microwave System.** The Authority has a 6-gigahertz microwave system running the length of the Parkway. The system is about 20 year old and decaying. Parts are hard to find. The Authority is considering replacing this system with a new digital microwave system, which could be a reliable, cost-effective supplement to fiber optic cable for toll and ITS-related communication along some segments of the Parkway.

- **Weather Stations.** The Authority has a SCAN weather station at the Driscoll Bridge over the Raritan River that serves two important functions. First, it enables maintenance managers to make better decisions about deploying snow and ice removal crews. Second, it alerts the operations staff to ice on the bridge so that a warning can be posted on a variable message sign upstream of the bridge.

- **Police and Wrecker Services**. The Parkway is well patrolled by New Jersey State Police who provide motorist assistance and traffic control at the scene of incidents. (See Figure 4-2). The police can quickly summon wrecker service to remove disabled vehicles. The police patrols and wrecker service are extremely valuable in minimizing the duration of lane closures caused by incidents.

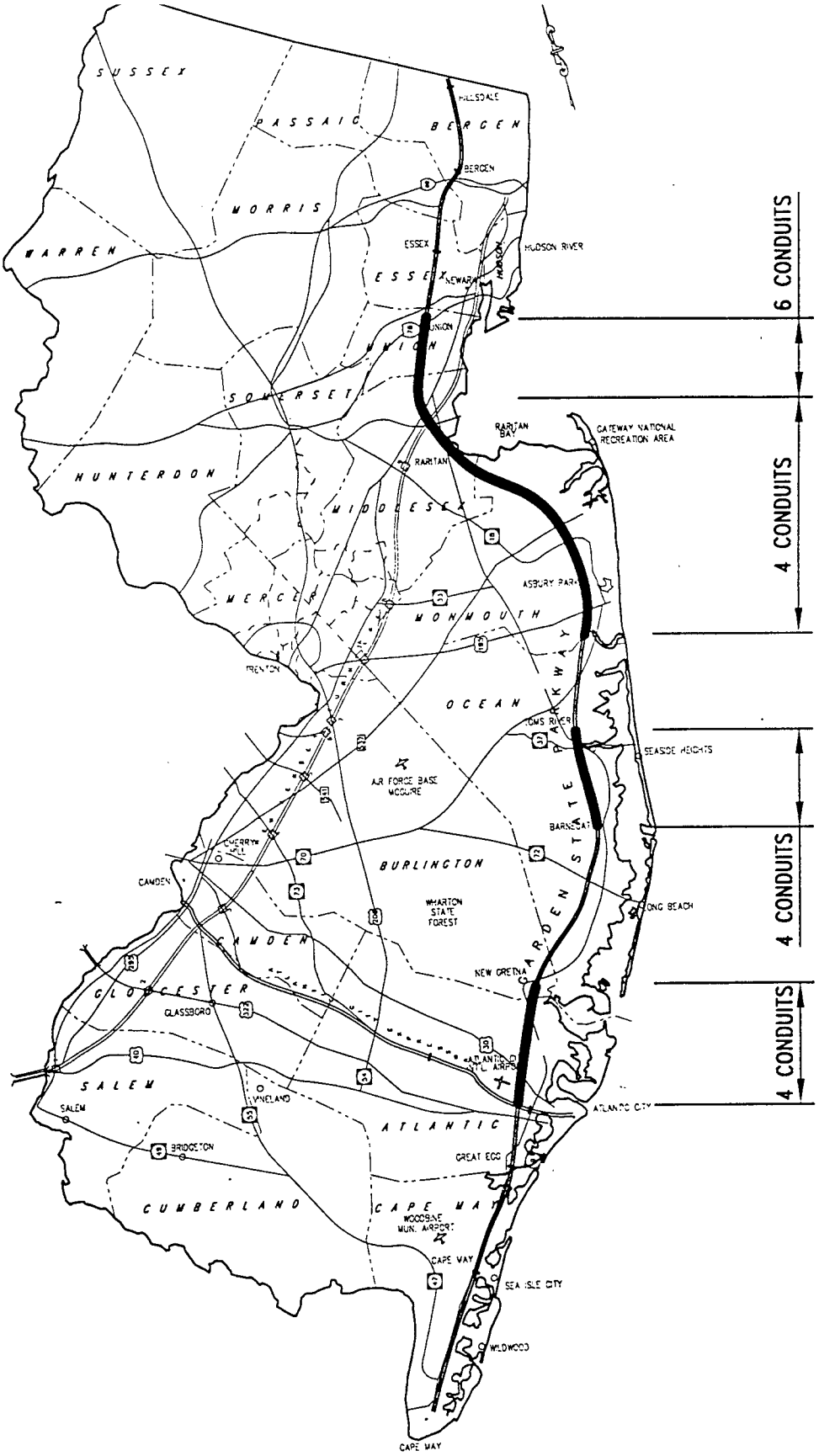


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Figure 4-1

Existing Fiber Optic Duct Banks

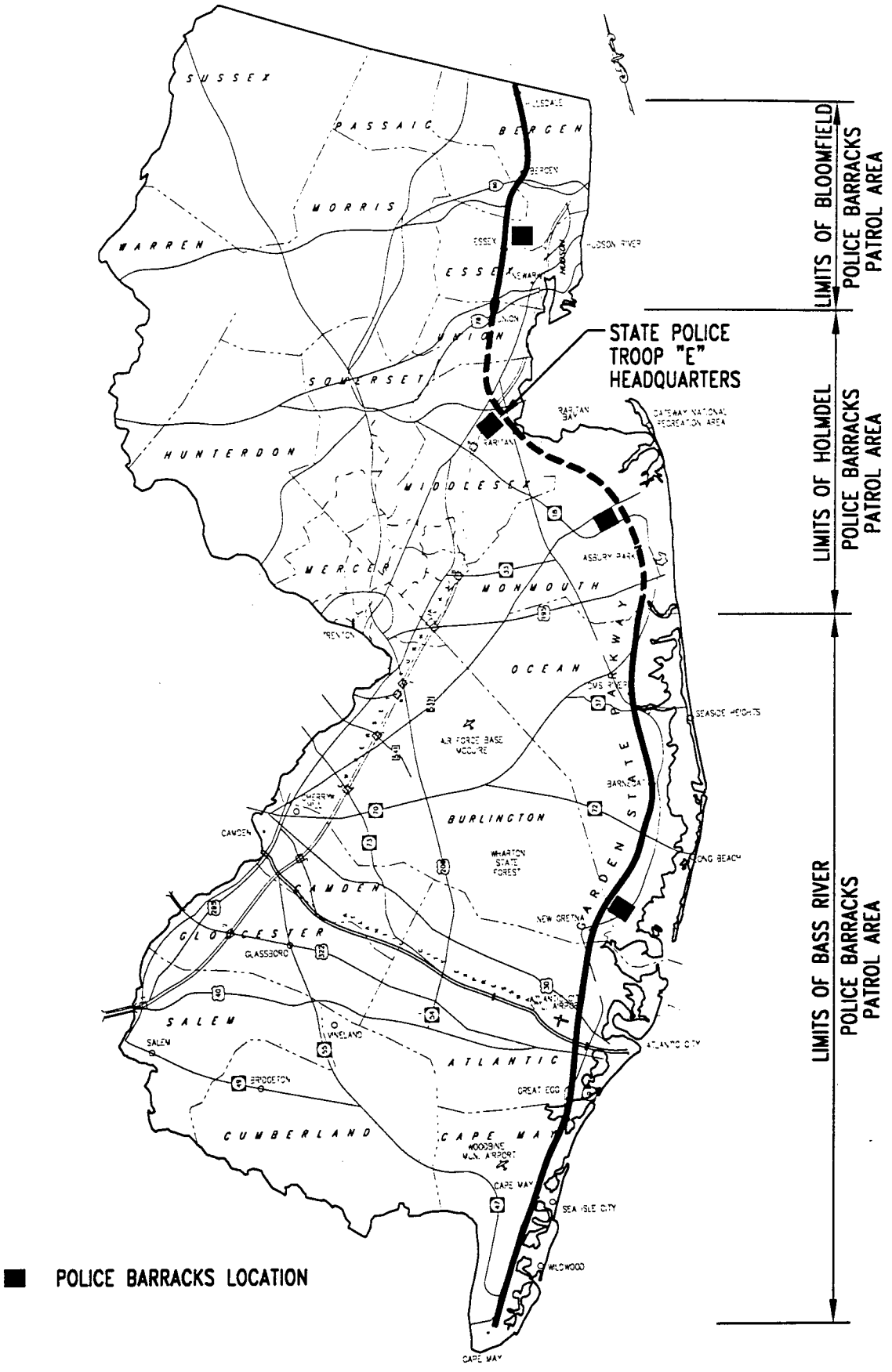

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Figure 4-2

Police Barracks Locations

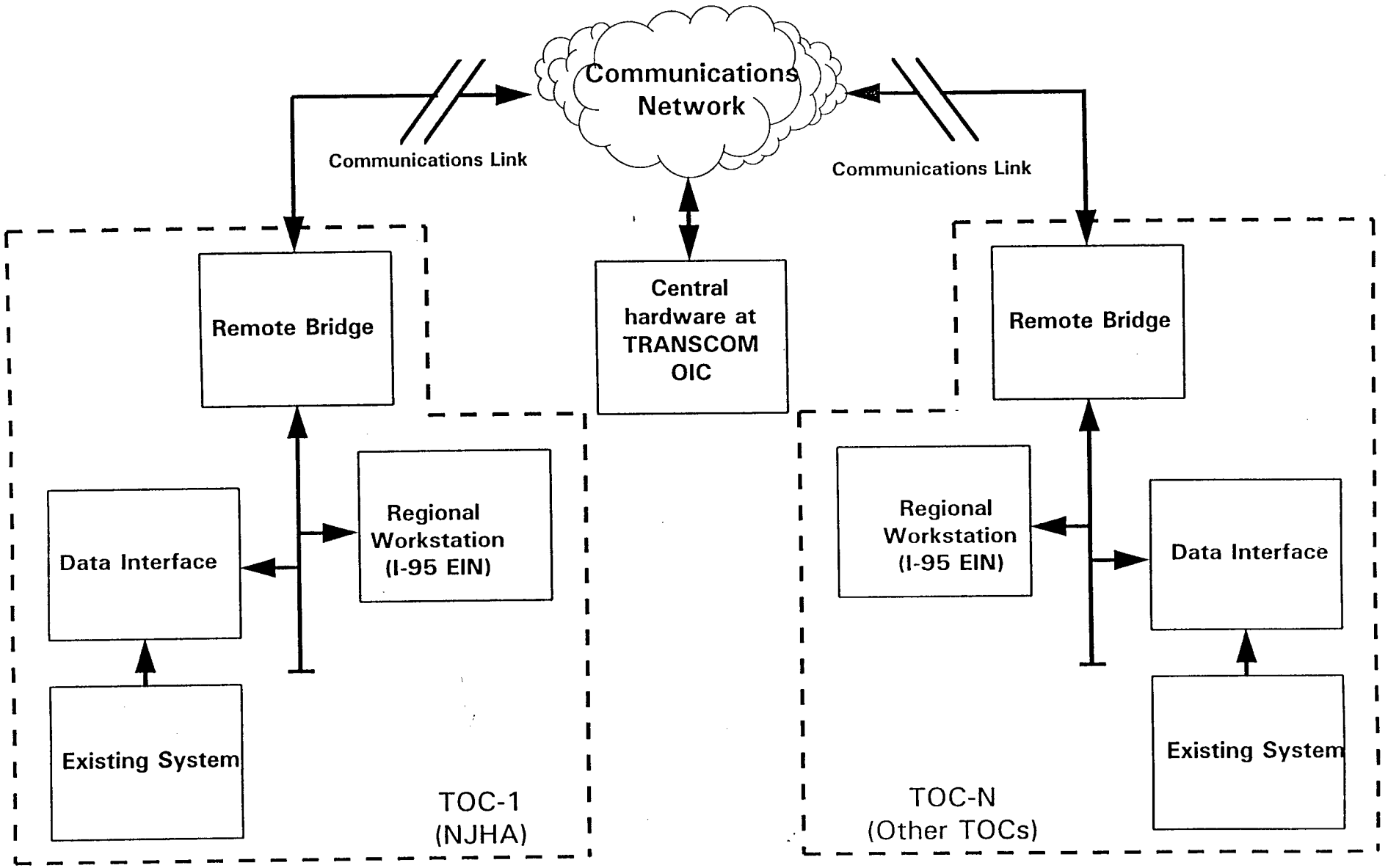
4.1.1 Interagency Relationships

Because traffic on the Parkway flows to and from roads belonging to several other state and multi-state agencies, it is to the motorists' benefit for the various agencies to share information about current traffic conditions and to coordinate their ITS and incident response activities.

4.1.2 Information Exchange

The Authority has for years been an active member of TRANSCOM, the consortium of transportation agencies that serves as an information clearing house for the greater New York metropolitan area. TRANSCOM conducted a study, in which the Authority participated, to recommend a "system architecture" to structure the flow of traffic and related data among the TRANSCOM member agencies. This system architecture is shown graphically in Figure 4-3.

More recently, the Authority has also become a very active member of the I-95 Corridor Coalition, a traffic information clearinghouse serving the entire northeastern United States. One of the most promising Coalition initiatives is the linking of the member agencies into a graphical information system that facilitates the exchange and display of traffic information of regional importance. This information system, or its successor, may someday be accessible to traffic reporters and individual travelers, and may become the primary means of information exchange among transportation agencies.



HARRIS

Figure 4-3
Adopted TRANSCOM Communications Architecture

4.2 PROGRAMMED ITS IMPROVEMENTS

In addition to this existing infrastructure the NJHA has programmed a series of other ITS related projects for implementation. These projects are summarized in Table 4-1 and in the text that follows.

4.2.1 Recurring Congestion

The E-ZPass system will have a major impact on recurring delay. The electronic toll collection system should increase the capacity of the toll plazas and obviate the need for toll plaza widenings.

Upgrades to signal systems should also reduce delay and mitigate recurring congestion. Signal upgrades were recently completed at three signals on the Garden State Parkway near the Cape May Court house.

4.2.2 Incident Management

Installing additional CCTV cameras, detector surveillance, and communications links to the traffic operations center will enhance the existing incident management and motorists' assistance program. These components will allow for more rapid identification of incidents which, in turn will expedite emergency vehicle responses. Other planned incident management enhancements include: strategically placing tow trucks during peak periods, improving call out policies, improving the radio communications system, conducting incident response training, and the overall improvement in traffic management during incidents through regional coordination strategies for major incidents.

4.2.3 Park and Ride

Constructing a new park and ride facility at milepost 109, the intermodal center at milepost 120, and the expansion of existing park and ride lots will increase park and ride activity in the corridor. Park and ride activity will also be enhanced through the NJHA's support of the carpooling initiatives of the Transportation Management Associations in the state.

4.2.4 Transit Operations

The NJHA recently began operating an alternate bus routing project, which advises buses approaching the Driscoll Bridge of delay on the mainline. With this information, drivers can choose to use parallel routes instead of the Parkway. This project has been well received since it began operation in 1996, and the NJHA is already planning to extend the coverage area.

4.2.5 Traveler Information

The NJHA, in an effort to disseminate traveler information, is planning to install additional VMS and HAR units, developed an Internet Home Page for the Parkway, and is using TRANSCOM and the I-95 Corridor Coalition to make other agencies aware of incidents.

4.2.6 ITS Planning

The NJHA is planning new initiatives and coordinating these initiatives with others through its participation in the development of TRANSCOM's Regional Architecture, the planning activities of the Committee for a Smart New Jersey (CSNJ), and the forthcoming efforts of the NY-NJ ITS Model Deployment Initiative.

4.3 UNMET NEEDS

Although the initiatives, both planned and underway, respond to some of the travelers' needs within the study corridor, it is clear that more should be done. The essence of this ITS Early Deployment Planning Study was to assess the areas where these needs are greatest, and then identify projects which will help address these needs. The twelve projects described in Section 3 carry the current program closer toward the long range program goal. It should be remembered, however, that these twelve projects represent only a portion of the ITS improvements that are recommended for improvement in the short and medium term implementation time frames. The additional ITS improvements recommended for implementation beyond the initial twelve are, at this stage, identified only in terms of market packages: components of the ITS National Architecture. These medium-term and long-term packages are listed on Tables 4-2 and 4-3, respectively.

Table 4-1

PREVIOUSLY PROGRAMMED AND ONGOING NJHA ITS INITIATIVES

INITIATIVES
Recurring Congestion
● Implement E-ZPass electronic toll collection ● Improve traffic signal systems in the corridor
Incident Management
● Install additional CCTV and detector surveillance ● Deploy tow trucks at the Driscoll Bridge during peak periods ● Review tow truck response policies to reduce response time ● Conduct incident response training ● Upgrade microwave radio system ● Implement communications backbone as part of E-ZPASS ● Establish regional coordination strategies for major incidents
Park and Ride
● Expand park and ride system ● Support carpooling initiatives by Transportation Management Associations
Transit Operations
● Extend the Alternate Bus Routing project
Traveler Information
● Install additional VMS and HAR units ● Establish a Home Page for the Parkway on the Internet ● Support multi agency / multimedia information dissemination through TRANSCOM and the I-95 Corridor Coalition
ITS Planning
● Participate in the development of TRANSCOM's regional architecture ● Participate in planning and coordinating activities of the CSNJ ● Participate in the NY-NJ Model Deployment Initiative

TABLE 4-2
USER SERVICE MARKET PACKAGES AND CANDIDATE PROJECTS WITH MEDIUM-TERM IMPLEMENTATION TIME FRAMES

USER SERVICE MARKET PACKAGE	CANDIDATE PROJECTS
Freeway Control (ATMS4)	• Install Ramp Metering at selected GSP on-ramps • Coordinate ramp metering w/ local signals • Install lane use signals on Driscoll Bridge, Union/Essex sections & other areas w/frequent accidents • Install Variable Speed Limit signs in areas w/ frequent accidents and areas prone to reduced visibility
HOV and Reversible Lane Management (ATMS5)	• Establish HOV lanes at Barrier Toll Plazas in conjunction with E-ZPass system • Identify potential HOV/reversible lanes on feeder routes to Parkway • Identify potential HOV/reversible lanes on feeder routes to NJ Tpk. HOV lanes
Regional Traffic Control (Coordination) (ATMS7)	• Support Transcom's coordination abilities • Establish regional coordination strategies for major incidents • Establish signal coordination procedures w/ local agencies
Emissions and Environmental Hazards Sensing (ATMS11)	• Establish a network to exchange weather & pavement data from existing systems • Install additional pavement temperature/ice detectors at selected locations • Install new fog detectors at selected locations
Transit Fixed-Route Operations (APTS2)	• Establish or enhance computerized route and scheduling capabilities
Demand Response Transit Operations (APTS3)	• Establish real-time computerized transit routing and passenger scheduling
Transit Passenger and Fare Management (APTS4)	• Accept use of Electronic Fare Cards on selected routes • Implement automatic passenger load monitoring
Transit Security (APTS5)	• Install onboard surveillance cameras • Provide CCTV surveillance at major transit stops
Dynamic Route Guidance (ATIS4)	• Collect and provide travel time data on the Parkway
ISP Based Route Guidance (ATIS5)	• Provide necessary data to Private Sector Information Service Providers
Yellow Pages and Reservations (ATIS7)	• Provide a directory of traveler services in the vehicles (Private Sector) • Expand information displays at GSP service areas (Private Sector)
Dynamic Ridesharing (ATIS8)	• Support real-time car-pool/rideshare database(s) of NJ Traffic Management Associations
HAZMAT Management (CVO9)	• Coordinate planning for HAZMAT incidents south of MP 105 • Participate in Public/private HAZMAT database coordination
Emergency Routing(EM2)	• Provide AVL for Parkway emergency vehicles • Implement computerized routing for emergency vehicles
Mayday Support (EM3)	• Provide interface to Mayday systems through a Geographic Information System

See notes on Page 4-11

Table 4-2 Continued

Notes:
- Within each implementation time frame, these User Service Market Packages are presented in order of their Package Number
- The implementation time frame associated with each User Service Market Package does not indicate that a particular project is feasible or worthwhile
- Candidate Projects are not shown in a priority order
- Sources of funding and implementing organizations will be identified in future tasks

TABLE 4-3
USER SERVICE MARKET PACKAGES AND CANDIDATE PROJECTS
WITH LONG-TERM IMPLEMENTATION TIME FRAMES

USER SERVICE MARKET PACKAGE	TYPICAL PROJECTS
Traffic Network Performance Evaluation (ATMS9)	• Short-term forecasts of traffic demand
Virtual TMC and Smart Probe Data (ATMS12)	• Distributed traffic management in rural areas; smart vehicle probes
Transit Maintenance (APTS6)	• On-board vehicle system monitors; automatic maintenance scheduling
Integrated Transportation Management/Route Guidance (ATIS6)	• Real-time optimization of traffic control based on the network performance evaluation
In-vehicle Signing (ATIS9)	• On-board display / vocalization of traffic signs (w/Private Sector)
Vehicle Safety Monitoring (AVSS1)	• In-vehicle sensors and display (Private Sector)
Driver Safety Monitoring (AVSS2)	• Drowsiness detector; DUI detector (Private Sector)
Longitudinal Safety Warning (AVSS3)	• On-board proximity sensors (front and rear) (Private Sector)
Lateral Safety Warning (AVSS4)	• On-board proximity sensors (sides) (Private Sector)
Intersection Safety Warning (AVSS5)	• Intersection collision warning sensors in the road and vehicle (w/Private Sector)
Pre-Crash Restraint Deployment (AVSS6)	• Pre-crash restraint deployment system (Private Sector)
Driver Visibility Improvement (AVSS7)	• On-board "heads up" vision enhancement display (Private Sector)
Advanced Vehicle Longitudinal Control (AVSS8)	• Acceleration and braking control system (Private Sector)
Advanced Vehicle Lateral Control (AVSS9)	• Steering control system (Private Sector)
Intersection Collision Avoidance (AVSS10)	• Intersection Safety Warning with vehicle control system (w/Private Sector)
Automated Highway System (AVSS11)	• Automated vehicle control systems and infrastructure
Fleet Administration (CVO1)	• Centralized vehicle dispatching and monitoring (Private Sector)
Freight Administration (CVO2)	• Automatic cargo tracking; on-board cargo monitoring (Private Sector)
International Border Electronic Clearance (CVO4)	• Electronic clearance and customs clearance
Weigh-In-Motion(CVO5)	• Weigh-In-Motion (WIM) systems
Roadside CVO Safety (CVO6)	• Citation and accident electronic recording; on-board commercial vehicle electronic data; roadside safety inspection (w/Private Sector)
On-Board CVO Safety (CVO7)	• On-board safety sensors (Private Sector)

See notes on Page 4-13

Table 4-3 Continued

Notes:
- Within each implementation time frame, these User Service Market Packages are presented in order of their Package Number
- The implementation time frame associated with each User Service Market Package does not indicate that any particular project is feasible or worthwhile
- Projects are not shown in a priority order
- Sources of funding and implementing organizations will be identified in future tasks

SECTION 5
OVERVIEW OF THE MAJOR SYSTEMS

5.1 INTRODUCTION

This section briefly describes the systems that are related to the twelve projects that have been selected for implementation. Many of these systems will be implemented as part of these projects. These systems are presented in Section 5.2. Section 5.3 describes existing systems or systems planned for implementation by others. It will be noted that in a few cases these systems are actually programs, practices or physical activities that will be implemented. Although these are not systems in the strictest sense, they are important elements that must be considered.

For convenience, the description of these systems within the next two sub-sections is divided into groups that correspond to the major components of the National ITS Architecture. However, we have only included the components that are actually represented by systems.

It should be noted that these systems are often related to more that one of the projects that have been selected for implementation in the short-term. A table has been included at the end of the section to show the relationship between them.

The systems that have been identified are the major systems that must be considered. Alternate listings identifying other systems are also possible, however, in almost all cases additional systems that can be identified are actually subsystems of the ones that have been included in this listing.

5.2 SYSTEMS SUPPORTING PROJECTS RECOMMENDED FOR SHORT-TERM IMPLEMENTATION

5.2.1 Advanced Traffic Management Systems

Electronic Toll Collection System. Each toll plaza in the corridor will be equipped for E-ZPass electronic toll collection. A statewide contract to install E-ZPass on all New Jersey toll roads was awarded in 1997. This electronic payment system may also be used in conjunction with the monitoring and operation of the park and ride lots. The electronic toll collection system will also provide several fiber optic fibers that will be used for data communications supporting the operation of the traffic management systems in the Parkway corridor. The installation of this communication system will also provide the communications link to the loop detectors forming the incident detection system previously installed between Woodbridge and Newark.

Video Surveillance System. NJHA, NJTA and NJDOT all use video cameras to monitor the flow of traffic on their roads. NJHA and NJDOT both have additional cameras for the corridor on the drawing boards. These cameras provide information about traffic flow, weather conditions, and snow cover. When an incident is reported or suspected, the camera enables the responsible agency to quickly determine what the situation is and what action is required. Appropriate rescue equipment is dispatched more quickly, blocked lanes are reopened sooner, and approaching motorists can be given more specific information about the delays ahead. The system should tie in to TRANSCOM's Interagency Remote Video Network (IRVN) so that other agencies can see video from selected cameras. Depending on agency policy, it may also include equipment to allow traffic reporters, including television stations, to have access to the video for their own use.

Toll Tag Surveillance System. This system will use the E-ZPass toll tags and supplementary tag readers to gather travel time data and identify incidents. The anonymity of the vehicle will be maintained by scrambling the ID number of the vehicle. This system will aid incident management and response by detecting incidents. This system is expected to be expanded with tag readers located along all of the major highways and arterials in the corridor to provide travel time data on major routes.

Incident Detection System and Data Base. This system would monitor the incident data coming from the toll tag readers, the eight-miles where detection will be provided through previously installed loop detectors, and will also log incidents that are entered into the data base from reports provided through the cellular phone call-in system, from police troopers or other NJHA personnel. The system will maintain a log of active and cleared incidents and will periodically prompt the operator to update the status of active incidents.

Traffic Monitoring System. This system will monitor the travel time data being returned by the toll tags and tag readers, the loop detectors providing volume counts to prepare overall summaries of traffic volume and speeds on the Parkway and adjacent roadways. This system will also support the dissemination of data through the NJHA's Home Page on the Internet.

Variable Message Signs and Highway Advisory Radio Systems. It is anticipated that many of the vehicles sold in the future will be equipped with devices that provide real-time traffic information. While the need for VMS and HAR units may not be completely eliminated, this availability of in-vehicle traffic information does imply that VMS and HAR units should only be installed where they are most critically needed and where their installations are inexpensive.

Signs Giving the Phone Number for Motorists to Report Incidents. NJTA has successfully operated an incident reporting system using both 911 and 1-800 service. The system results in quicker help for motorists in trouble as well as quicker opening of blocked lanes. This system could be expanded to cover the entire state with a single phone number.

Telephone System and Staff to Receive Incident Reports. A single conspicuous incident may generate dozens of calls from passing motorists. In conjunction with the additional signing, the Traffic Operations center must have a telephone system with the capacity to handle a high volume of calls and sufficient personnel to answer them.

5.2.2 Advanced Public Transit Systems

Bus Schedule Display System. This system will show the estimated arrival times for buses based on the bus's current location and current traffic conditions. The displays would be located at Park and Ride lots and at other public places.

Automatic Vehicle Location Systems. Some transit buses will have an automatic vehicle location system which periodically provides the location of the vehicle to a central computer at the transit operator's headquarters. NJ TRANSIT has had such a system in place on a pilot basis for several years.

Transit Route Deviation System. This system in the transit bus will let the bus driver know that he should deviate from his usual route. One application of this system would be to make a bus driver aware of passengers waiting at a park and ride lot. Another application is in alternate route systems like the one in Woodbridge that directs the driver to a service road instead of the Parkway mainline if the alternate route offers a significant time savings.

5.2.3 Advanced Traveler Information Systems

Kiosk Information System. These will monitor data relating to road travel and public transportation. The system will be able to tell the user not only how long it will take to drive from Point A to Point B and give the driver step-by-step instructions on how to get there, but also what the public transportation alternatives are, with travel time and fare information. These devices are also likely to incorporate directories of restaurants, motels, attractions, hospitals and other points of interest, and will automatically figure the best route and estimate how long it will take to drive there. They will be in Parkway rest areas, Park and Ride lots, shopping centers, hotels, casinos, large office buildings, and other major trip generators. They will be owned, operated, and maintained by the private companies that broadcast the data. On-screen advertising may help generate the revenue to pay for them. Such systems are in production now, except that the delivery and use of current traffic information is still under development.

5.3 ADDITIONAL SYSTEMS IN PLACE OR SCHEDULED FOR SHORT-TERM IMPLEMENTATION IN THE CORRIDOR

5.3.1 Advanced Traffic Management Systems

Traffic Signal Systems. NJDOT is upgrading its signal systems all over the state, including the Parkway corridor. Some parts of Routes 4, 7, 9, and 17 have already been upgraded. Further improvements on Route 9 and several other roads in the corridor are planned. NJHA uses a closed loop system to control the signals on the Parkway. Continued signal system improvements are important, and should include coordination of signals belonging to different agencies, as well as provision for optimal operation when incidents cause signalized arterials to handle unusually heavy loads.

Regional Traffic Data Exchange System. TRANSCOM is in the process of implementing a Regional ITS Architecture. This architecture features a computer on a wide area network that connects all TRANSCOM member agencies. A similar network will serve transportation agencies in South Jersey. The computer runs a geographic information system (GIS) that presents a map showing current traffic conditions, work zones, incidents, and the location of traffic management tools such as cameras, HAR, and changeable signs. Clicking on symbols, such as signs or incidents, causes a box with detailed information about the item to pop up on the screen. The display pulls together in one place all the data from the various agencies serving the region. Each traffic operations center will have a system in place to automatically pass along to TRANSCOM the latest information of interest to travelers or other transportation agencies. The information will include not only data but also video from selected cameras. TRANSCOM will then handle the distribution of this information to other transportation agencies (including the I-95 Corridor Coalition, if appropriate) and to private sector information service providers.

Incident Management Plans. These are area-wide plans for likely future incidents, developed jointly by all the transportation and emergency response agencies involved, including the local governments and agencies in adjacent states. They include identifying diversion routes and the associated traffic control and motorist information activities. They also include traffic signal timing plans designed to handle the flood of traffic on the diversion routes. In addition, the plans should include planning for hazardous materials incidents. The NJDOT, the New Jersey State Police and the I-95 Corridor Coalition are now doing this on a regional basis.

Incident Response Training. This entails both classes and exercises to prepare the transportation and emergency response agencies to carry out the incident management plans in a coordinated fashion. The I-95 Corridor Coalition is currently considering this action.

Motorist Assistance Patrols. The New Jersey State Police provide this service on all the toll roads in the Parkway corridor, and NJDOT provides it on selected roads in South Jersey. These not only provide surveillance of major roads, but also remove hazards, unblock lanes, and assist stranded motorists when problems are found.

Tow Trucks at Key Locations. Tow trucks are currently stationed at the Driscoll Bridge during rush hours to expedite the removal of disabled vehicles and maintain traffic flow.

Weather Monitoring Systems. NJHA has one roadside weather station, and NJDOT has several roadside weather stations in the corridor. The primary function of the stations is to enable the agencies to better predict when snow and ice removal will be required. This improved accuracy provides travelers with safer roads at lower cost. Also, when the stations are at bridges, as they usually are, they can alert the agencies to hazardous icing on the bridge. Weather stations at locations plagued by heavy fog should be equipped with fog detectors, so that motorists can be warned of that hazard. The operations staff should have direct access to the weather information, with automatic alarms for hazardous conditions like heavy fog and icy bridges. By the same token, the maintenance staff managing snow and ice removal should have full access to the video system to see how the work is progressing.

5.3.2 Advanced Traveler Information Systems (Under Development by Others)

Pager Systems. Pagers will be used to alert users to major traffic problems, such as bridge closures. These systems will be implemented by the private sector and will use information on traffic incidents provided by TRANSCOM.

Telephone Based Information Systems. Information about current traffic conditions and recommended routes will be available, for a fee, from private companies such as Bell Atlantic Nynex.

Personal Computer Systems. Full size and portable personal computer systems will have capabilities and displays similar to the in-vehicle route guidance systems, but without the subsystems that determine the current location and heading. They may receive data about current traffic conditions via radio receivers, or through a direct telephone connection to information providers or the Internet. The data received on this link may also include public transportation schedules. Thus, the personal computer system can tell the user not only how long it will take to drive from Point A to Point B, but also what the public transportation alternatives are, with travel time and fare information.

In-Vehicle Route Guidance Systems. These systems will continually determine the road the vehicle is on, its position and heading. The systems will also monitor broadcast data relating to road segment travel times, current incidents, work zones, weather, and parking availability. A computer will find the best route to the vehicle's destination based on its

current location and the broadcast travel times, and give the driver instructions on how to get to his destination. These devices are also likely to incorporate directories of restaurants, motels, attractions, hospitals and other points of interest, and will automatically figure the best route and estimate the travel time. Such systems are in production now, except that the delivery and use of current traffic information is still under development.

Ride Sharing Database. People who want to form or join carpools will be assisted through the New Jersey Transportation Management Association's real-time ridesharing data base.

5.3.3 Emergency Management

Cellular phones. These phones will differ from today's models in that they will know the vehicle's location. (This is a provision of the Federal Communications Commission's requirements for Enhanced 911 service.) When a motorist calls for assistance, or calls to report an incident, the cellular phone will automatically transmit the vehicle's phone number and location, permitting a computer to immediately show the vehicle's position on a map. The primary benefit of this feature is to ensure that emergency responders go directly to the right place. A secondary benefit is that it will alert the dispatcher if the call is a prank. The phones will also be designed to interface with a "Mayday" system, automatically placing a call for help if an air bag has inflated or if the driver has pushed a panic button in the vehicle.

5.3.4 ITS Planning

Coordination of Intelligent Transportation System (ITS) Activities. The coordinated planning and implementation of ITS capital improvements and operations will continue with neighboring agencies, and will include the regional ITS architecture under development by TRANSCOM.

5.4 RELATIONSHIPS AMONG THE SYSTEMS AND PROJECTS SELECTED FOR IMPLEMENTATION

The relationships among the systems and the projects selected for implementation in the short-term are identified in table 5-1 on the following page.

TABLE 5-1
RELATIONSHIP BETWEEN MAJOR SYSTEMS AND SHORT TERM PROJECTS

● Systems Required to Enable Projects
◒ Systems Supported by Project Outputs
○ Other Related Systems and Projects

SYSTEMS \ PROJECTS	Install CCTV and Detector Systems	Install Signs with Phone Numbers for Emergency Assistance	Extend TRANSMIT Surveillance	Process and Disseminate Travel Time Data	Install VMS and HAR Systems	Establish a Home Page with Real-Time Information	Upgrade TOC	Incorporate ITS Based Parking Systems	E-Z PASS Based Bus Location Systems	Bus Routing to Park and Ride Areas	Provide Real Time Transit Schedules	Information Kiosks at Service Areas
Electronic Toll Collection System	●		●	●	○	●	●	●	●	●	●	○
Video Surveillance System	●	○			○	○	●					
Toll Tag Surveillance System	○		●	●	○	●	●		●	●	●	○
Incident Detection System and Data Base	◒	◒	◒	○	○	●	●					○
Traffic Monitoring System	◒		◒	●	○	●	●		○			○
Variable Message Signs and Highway Advisory Radio Systems	◒	◒	◒	◒	●		●	◒				
Signs Giving the Phone Number for Motorists to Report Incidents		●			○		○					
Telephone System and Staff to Receive Incident Reports		●			○		●					
Traffic Signal Systems							○					
Regional Traffic Data Exchange System	◒	◒	◒	◒	○	○	◒	◒				○
Incident Management Plans	○	○	○				○					
Incident Response Training	○	○	○				○					
Motorist Assistance Patrols	○	○	○				○					
Tow Trucks at Key Locations	○	○	○									
Weather Monitoring Systems					○	○	○					○
Bus Schedule Display System									◒	◒	●	○
Automatic Vehicle Location Systems for Buses			◒						●	●	●	○
Transit Route Deviation System			◒	◒					◒	●	○	
Kiosk Information System	◒	◒	◒	◒		○	◒		◒	○	◒	●
Pager Systems	◒	◒	◒	◒			◒					
Telephone Based Information Systems	◒	◒	◒	◒			◒		◒			
Personal Computer Systems	◒	◒	◒	◒			◒		◒			
In-Vehicle Route Guidance Systems	◒	◒	◒	◒			◒					
Ride Sharing Database						○						○
Cellular phones		●										
Coordination of Intelligent Transportation System (ITS) Activities												

SECTION 6
SYSTEM ARCHITECTURE

A companion report, System Architecture, presented in meticulous detail the overall design of the system architecture and the details associated with the market packages and equipment packages that provide services to travelers in the corridor. It identifies these subsystems, the sources and users of the ITS information, and all the data flows among those components. It documents precisely how each component of the NJHA ITS will relate to the other components. Figure 6-1, a summary diagram taken from that report, indicates the scope and complexity of that task.

The benefit of documenting the system architecture in detail is minimizing unanticipated replacement and upgrading of equipment installed early in ITS implementation. The system architecture enables someone designing an equipment package or communication link to see all the functions that the equipment or link will handle in the future.

6.1 THE TWELVE INITIAL PROJECTS

Section 2 of this report described 12 projects that are the recommended first steps to making the Garden State Parkway Corridor a smart corridor. This chapter summarizes the system architecture for the twelve projects and discusses the implications for the associated equipment specifications and communication links.

Figure 6-2 is a diagram from the system architecture report that shows the relationships among the ITS components associated with the 12 initial projects. It is similar to Figure 6-1, except that Figure 6-1 includes additional components of the architecture needed to support future projects, not just the first 12.

Tables 6-1 and 6-2 also describe aspects of the system architecture. Table 6-1 shows, for each subsystem involved in the twelve projects, the other subsystems with which it communicates. Table 6-2 lists the same communication links shown in Table 6-1, but also identifies the type of information being communicated. (See figures 6-1 and 6-2)

6.2 TRAFFIC MONITORING WITH CCTV AND DETECTOR SYSTEMS

When initially installed, the CCTV cameras will enable the NJHA TOC staff to see traffic flow, confirm suspected incidents, determine the appropriate emergency response for incidents, and observe the operation of variable message signs. The video will likely be shared, via TRANSCOM, with other transportation agencies and with information service providers.

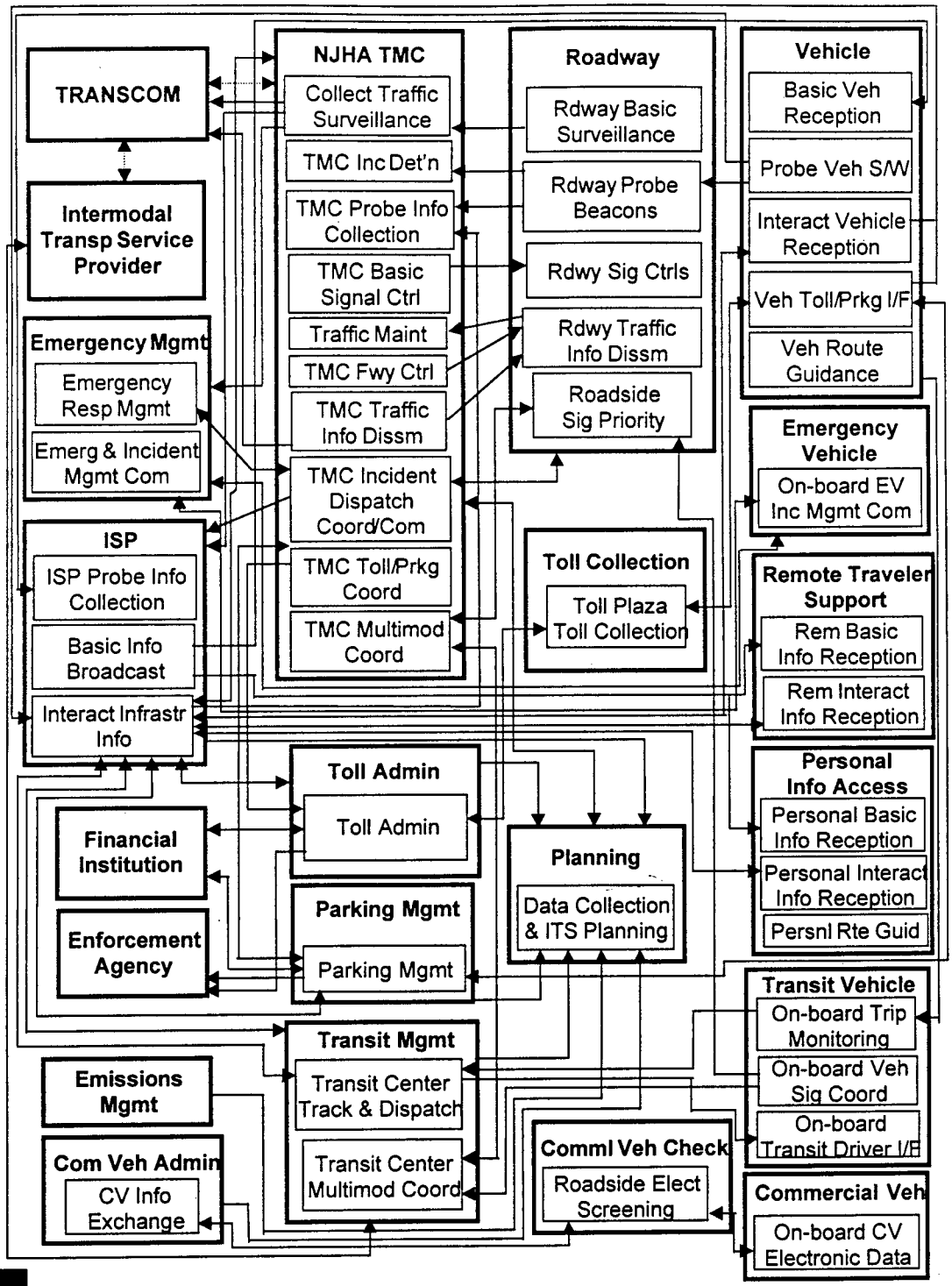


Figure 6-1
Composite System Architecture Development from the NJHA Short-Term Implementation Time Frame Market Packages

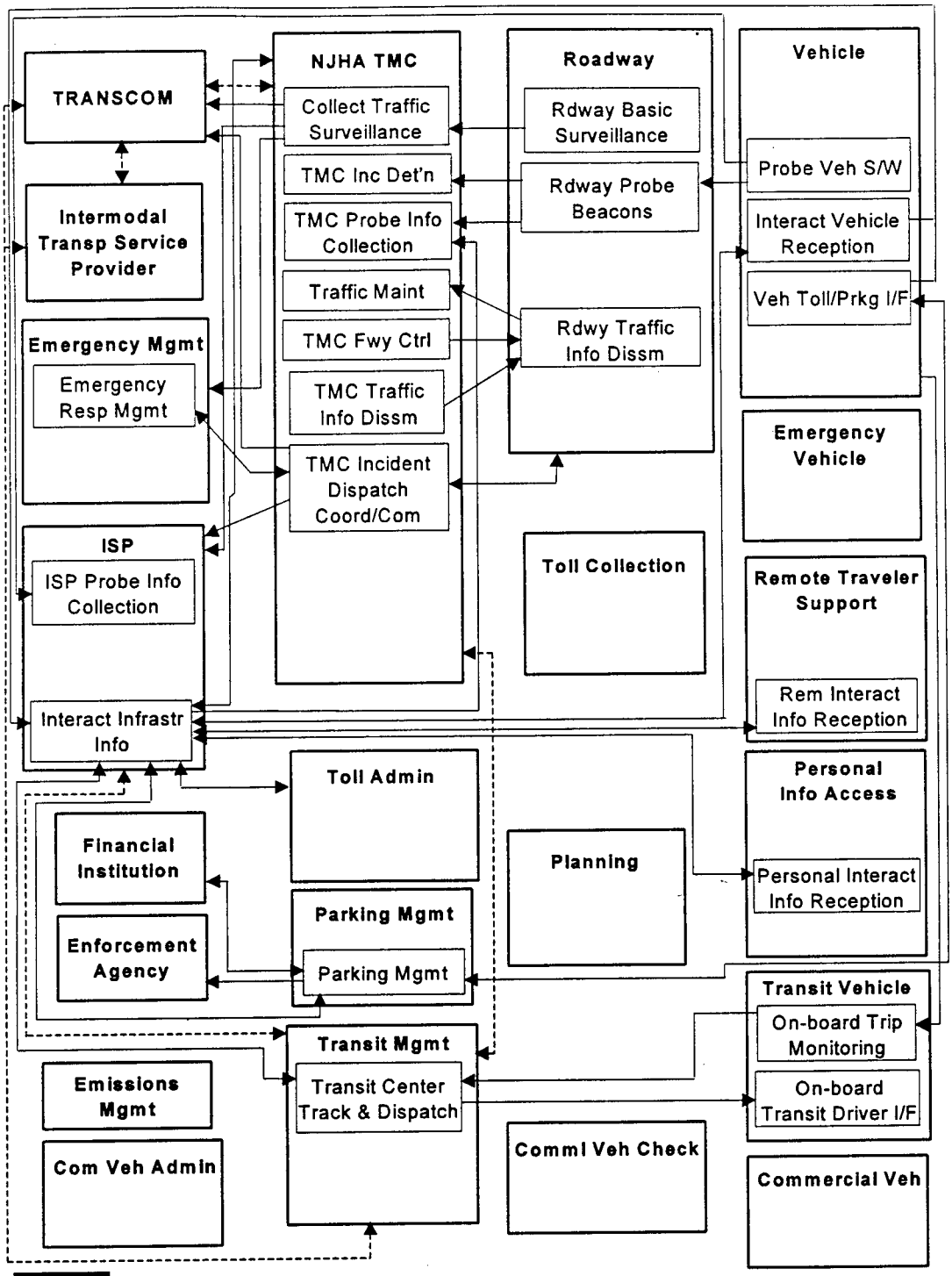


Figure 6-2
System Architecture Development for the Short-Term Implementation Time Frame NJHA Priority Projects

Table 6-1

IDENTIFICATION OF DATA EXCHANGE PATHS AMONG ARCHITECTURE SUBSYSTEMS AND MAJOR GROUPS FOR THE SHORT-TERM IMPLEMENTATION TIME FRAME PRIORITY PROJECTS

	Transmitting Subsystems																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Centers																										
1. NJHA TMC		x	x		x	x						x						x	x			x				
2. Information Service Provider	x			x		x								x				x	x							
3. Emergency Management	x														x											x
4. Toll Administration	x	x								x																
5. Parking Management										x				x												
6. Transit Management	*x*	x														x		x								
7. Intermodal Transportation Service Provider																										
8. Commercial Vehicle Administration													x											x		
9. TRANSCOM	*x*	*x*	*x*		*x*	*x*	*x*																			
10. Financial Institution				x	x																					
11. Enforcement Agency				x	x																					
Roadside																										
12. Roadway	x													x												
13. Commercial Vehicle Check								x									x									
Vehicles																										
14. Vehicle (Automobile)		x			x															x	x		x			
15. Emergency Vehicle			x																							
16. Transit Vehicle						x								x												
17. Commercial Vehicle													x													
Remote Access																										
18. Remote Traveler Support	x	x				x																				
19. Personal Information Access	x	x																		x	x					
Terminators																										
20. Location Data Source (terminator)																										
21. Map Update Provider (terminator)																										
22. Other TMCs (terminator)	x																									
23. Payment Instrument: E-ZPass (terminator)														x												
24. Other CVAS (terminator)								x																		
25. Commercial Vehicle Driver (terminator)													x				x									
26. Other Emergency Management (EM) (terminator)			x																							

An *x* in italics indicates a data exchange that is not required by the the initial 12 projects, but one that may be desirable to ensure regional coordination in the Garden State Parkway Corridor

Table 6-2

DATA EXCHANGES BETWEEN ITS SUBSYSTEMS TAILORED FOR THE SHORT-TERM IMPLEMENTATION TIME FRAME NJHA PRIORITY PROJECTS

SUBSYSTEM PAIR	DATA	MARKET PACKAGE
NJHA TMC → Info Service Provider	traffic info	ATMS 1
Info Service Provider → NJHA TMC	request for traffic info	
Roadway → NJHA TMC	local traffic flow	
NJHA TMC → Other TMCs	TMC coordination	
Other TMCs → NJHA TMC	TMC coordination	
Roadway → NJHA TMC	vehicle probe data	ATMS 2
Roadway → NJHA TMC	freeway control status	
Roadway → NJHA TMC	incident data	
NJHA TMC → Roadway	freeway control data	
Info Service Provider → NJHA TMC	road network use	
Vehicle → Info Service Provider	vehicle probe data	
Vehicle → Roadway	vehicle probe data	
Location Data Source → Vehicle	position fix	
Map Update Provider → Vehicle	map updates	
NJHA TMC → Roadway	signage data	ATMS 6
Info Service Provider → NJHA TMC	traffic information request	
NJHA TMC → Info Service Provider	traffic information	
NJHA TMC → Emergency Management	incident notification	ATMS 8
Emergency Management → NJHA TMC	incident information	
Emergency Vehicle → Emergency Mgmt	emerg veh driver status update	
NJHA TMC → Info Service Provider	traffic information	
NJHA TMC → Roadway	signage and radio control data	
NJHA TMC → Roadway	freeway control data	
Roadway → NJHA TMC	freeway control status	
Roadway → NJHA TMC	local traffic flow	
Roadway → NJHA TMC	incident data	
Roadway → NJHA TMC	vehicle probe data	
Roadway → NJHA TMC	sign and radio control status	
NJHA TMC → Other TMCs	TMC coordination	
Other TMCs → NJHA TMC	TMC coordination	

Table 6-2 (continued)

DATA EXCHANGES BETWEEN ITS SUBSYSTEMS TAILORED FOR THE SHORT-TERM IMPLEMENTATION TIME FRAME NJHA PRIORITY PROJECTS

SUBSYSTEM PAIR	DATA	MARKET PACKAGE
Vehicle → Payment Instrument	request for payment	ATMS 10
Vehicle → Parking Management	tag data	
Payment Instrument → Vehicle	payment	
Parking Management → Vehicle	request tag data	
Parking Management → Vehicle	tag update	
Parking Management → NJHA TMC	parking availability	
Parking Mgmt → Financial Institution	payment request	
Parking Mgmt → Enforcement Agency	violation notification	
NJHA TMC → Info Service Provider	parking availability	
Financial Institution → Parking Mgmt	transaction status	
Transit Vehicle → Transit Management	vehicle probe data	APTS 1
Transit Vehicle → Transit Management	tran veh passenger & use data	
Transit Management → Transit Vehicle	driver instructions	
Rem Trav Sup → Tran Mgt (or Tran Veh)	trip request	
Tran Mgt (or Tran Veh) → Rem Trav Sup	trip confirmation	

Clearly, video surveillance of such locations could both improve security and reduce responses to false alarms. The candidate locations for such future cameras should be identified prior to installing the roadway surveillance cameras, so that provision can be made to serve both sets of cameras with the same communication system where practical.

The second component of the camera/sensor project is, of course, traffic sensors. The sensors will provide the NJHA TOC staff with current traffic volume data for various locations along the corridor. Like the video, this data is likely to be passed along, via TRANSCOM, to other transportation agencies and information service providers.

The system architecture indicated that, in the future, there are likely to be environmental sensors in the corridor gathering weather and air pollution data. The value of that data would be greatly increased, we believe, if it were related to the associated traffic flow. To that end, we recommend that candidate sites for the environmental sensors be identified prior to siting the traffic sensors, and that the sites be coincident where practical. The communication link for the detectors should be designed to carry emission data as well.

6.3 ADVERTISE EMERGENCY ASSISTANCE PHONE NUMBERS WITH HIGHWAY SIGNS

This system entails the communication of voice information and vehicle location data from vehicles to the NJHA or State Police TOC staff, which can note information needed for traffic management. The system architecture also provides the capability of supporting future communication between emergency response agencies and locations, such as park-and-ride lots. The information pertinent to traffic will be shared, via TRANSCOM, with other transportation agencies and with information service providers.

The system architecture revealed no future additions with a bearing on the incident reporting project.

6.4 COLLECT TRAVEL TIME DATA IN THE PARKWAY CORRIDOR

TRANSMIT is an existing system for monitoring traffic flow and detecting incidents. It tracks vehicles equipped with E-ZPass toll tags as they travel past a series of locations equipped with tag readers. It continuously calculates the average travel time between consecutive locations. A sudden, unexplained increase in travel time over a particular

segment indicates a possible incident on that segment. The new project will expand the TRANSMIT system to cover much of the Parkway Corridor and many of the major roads in the corridor.

One opportunity for project coordination is to locate some of the tag readers at locations that also have the vehicle sensors described earlier. By comparing the number of successful tag reads to the counts from the vehicle sensors, NJHA staff could estimate the market penetration of E-ZPass by location and time period and will estimate volumes at adjacent locations that are only equipped with tag readers. If the vehicle sensors could distinguish between different types of vehicles, then the staff could also estimate E-ZPass penetration by type of vehicle. This information should be valuable to those planning and marketing E-ZPass. Locating tag readers and detectors together should also produce some savings in communication-related costs.

The system architecture revealed that the E-ZPass electronic toll collection system is to be used for other purposes such as the collection of fees at the park and ride lots.

The system architecture also supports a future emergency vehicle tracking system. While the toll tag readers installed in this project will be too far apart for precise vehicle location, there may be some benefit to using location data collected via the toll tag readers to supplement that collected by other means. This option should be explored prior to expanding TRANSMIT because there may be instances in which the TRANSMIT tag readers could be sited to maximize their value for transit vehicle tracking. The potential use of the tag readers to track transit vehicles (or commercial vehicles or NJHA maintenance vehicles) could also affect the communication between the tag readers and the central equipment.

6.5 PROCESS AND DISSEMINATE REAL-TIME TRAVEL DATA

Via TRANSCOM, NJHA will pass the segment travel times from the expanded TRANSMIT along to other transportation agencies and information service providers. It will also be made available to the public via the Internet.

The system architecture supports the NJHA will send a great deal of other information via TRANSCOM to other transportation agencies and to information service providers. The discussion above has already mentioned roadway surveillance video, traffic volumes at vehicle sensor locations, and incident reports. Other data supported by the system

architecture includes:

- Other traffic information (e.g., road conditions in bad weather)
- Current toll rates (demand sensitive)
- Current parking rates (demand sensitive)
- Parking availability

In addition, the architecture supports a similar flow of video and data in the reverse direction, from TRANSCOM to NJHA.

Rather than being limited to the data formats and communication links needed to disseminate the travel time data, this project should entail a comprehensive look at all the information flowing between NJHA and TRANSCOM. The data formats and communication links designed in this project should be able to handle all the data and video that will eventually be exchanged.

6.6 EXPAND VMS/HAR SYSTEMS

This project will provide motorists with current information about traffic conditions, entails installing roadside equipment and establishing communication links to that equipment. The system architecture revealed no need to coordinate with future ITS enhancements, except for placing the signs and radio transmitters near other NJHA roadside equipment to minimize the cost of providing power and communication to the equipment.

6.7 ESTABLISH A PARKWAY HOME PAGE WITH REAL-TIME TRAVELER INFORMATION

This project will give travelers current information about traffic and parking availability throughout the corridor, including current speeds, current incidents and construction activity, transit schedules for park-and-ride lots, best exits for attractions, and the PNC Bank Arts Center schedule of events. It may also provide snap shots of traffic from the CCTV system.

The system architecture supports the transmission of this data to independent service providers and TRANSCOM. Those organizations, however, would also have comparable

information from other transportation agencies. That would put them in a position to establish web sites that provide the same information as NJHA's site, as well as other roads, lots, and transit lines in the metropolitan area. Clearly, a traveler would much prefer to visit a single web site providing all the information he needs to plan a trip, rather than having to visit a succession of sites, each providing information about a different portion of the trip, or a different travel alternative. Especially in the greater New York metropolitan area, the eventual emergence of one or more web sites providing high quality traffic, parking, and transit data for all roads in the region seems inevitable.

To avoid duplication of efforts, the web site project should be coordinated with other organizations' web site projects. In particular, there should be hot links between the sites so that when a user on another web site wants information not available on the site he is using, such as services available at each Parkway service area or a view from one of the other CCTV cameras on the Parkway, he is automatically transferred to the NJHA web site.

6.8 UPGRADE THE PARKWAY TRAFFIC OPERATIONS CENTER

This project consists of providing software, hardware, and new structure to convert NJHA's Communication Center into a Traffic Operations Center. Clearly, the enlarged facility should accommodate not just the people and equipment required for the initial twelve projects, but also the other ITS projects NJHA expects to carry out. The system architecture identifies the following future activities that will require space at the TOC:

- Traffic signal control monitoring and
- Environmental monitoring.

6.9 ENHANCE MANAGEMENT OF PARK & RIDE LOTS WITH ETTM TECHNOLOGY

This project entails improving existing park-and-ride lots, creating new ones, installing changeable signs to alert approaching motorists when lots are full, and extending the E-ZPass system to include electronic collection of parking fees. The E-ZPass tag readers should be incorporated into the TRANSMIT expansion project discussed earlier. The system for determining whether the lot is full should not only control the changeable signs but should also be tied into the travel time dissemination project and the Internet web site, both discussed earlier.

The system architecture indicates no future projects that should be coordinated with this one.

6.10 OPERATE A BUS LOCATION SYSTEM WITH ETTM TECHNOLOGY

This project entails using toll tag readers to track the progress of buses along their routes. This would allow the transit provider to take corrective action when a bus was seriously off schedule, and permit it to provide passengers with continuously updated estimates of arrival times.

This project should make use of the tag readers installed in three other projects: TRANSMIT expansion, electronic toll collection, and electronic parking fee collection. Any tag readers installed primarily for the bus location system should also feed data to TRANSMIT. Electronic toll collection is a future project called out in the system architecture.

Data from all the toll tag readers will go to NJHA headquarters, so communication links will have to be established to relay the bus-related data from NJHA to the appropriate bus operator. The system architecture calls out other data flows between NJHA and the bus operators. These are:

- Transit system data, such as the location of broken down buses on the Parkway. This will normally flow from the transit provider to NJHA.

- Signal priority requests and status

Before the communication links for the bus operating system are designed in detail, it would be wise to investigate the practicality of using the same links for all the data that NJHA will be exchanging with the transit providers. There may also be an opportunity to use NJHA's communication links to roadside equipment and parking lots as part of the communication system links transit providers to their buses and bus stops.

6.11 OPERATE A STOP-ON-DEMAND BUS SERVICE THROUGH PARK & RIDE LOTS

The goal of the project is to allow a bus to bypass NJHA's park-and-ride lots unless there are passengers in the lot waiting for that particular bus. A traveler needing a bus would use some sort of communication device, probably a kiosk, to request transportation to his

specific destination. The request is communicated to the appropriate transit provider, who sends the traveler a response indicating the anticipated pickup time.

The system architecture includes several future systems that could make use of the same kiosk as the bus request system:

- A security system enabling travelers to contact emergency response agencies for help.
- A system to provide travelers with information about how to use public transportation to get between two points.
- A system to provide travelers with information about public transportation fares and schedules.
- A system to enable travelers to purchase tickets and make reservations for public transportation, including demand-responsive transit.
- "Yellow pages" information about attractions and businesses of interest to travelers.

In addition, there will be other communication equipment besides the kiosk(s) at the park-and-ride lots: the system to detect full parking lots; the toll tag readers used for bus location; and, perhaps, video cameras for security. The communication needs for all this equipment should be considered together, rather than project-by-project.

6.12 DISPLAY REAL-TIME TRANSIT SCHEDULE INFORMATION AT PARK & RIDE LOTS

This project entails a display at the park-and-ride bus stop giving the expected arrival time for the next bus on each route serving the lot. This is another project that might be able to share a kiosk and communication links with the projects listed in the preceding section.

6.13 OPERATE INFORMATION KIOSKS AT THE SERVICE AREAS (PRIVATE SECTOR)

This project entails installing kiosks at service areas and park-and-ride lots to provide current transportation information, sell transportation and show tickets, reserve hotel rooms, and give directions for travel between two points. The current transportation information would be provided by TRANSCOM.

There are three areas in which this project should be coordinated with others. First, much of the information provided will be the same as would be displayed on NJHA's web site, so the possibility of using a common data base and common graphics for both projects should be investigated. The system architecture indicates that in the future, information service providers are expected to offer trip planning service, in which the ISP would tell the traveler the best way to travel between to points based on current traffic (or transit) conditions. The system architecture also indicates that information service providers will be providing travelers with current traffic information via "personal information accessories" and in-vehicle displays. The same data base and, perhaps, graphics could also be used for all of these services. There is also the possibility of integration of the "yellow pages" function, in that a traveler could select a tentative destination from the businesses listed in the yellow pages and immediately be given instructions on how to get there and an estimate of the travel time.

The second area for coordination is the kiosks themselves. The kiosks installed in the parking lots for this project could also be used for functions called out as other projects, such as current transit schedule information and the ability to request bus service.

The third area for coordination is the communication links to the equipment in the parking lots. Even if the kiosks in this project are separate from the equipment used for the real time schedule information, the bus request system, and the future projects listed in the discussion of the bus request system, it may still be practical for them to share some of the same communication infrastructure.

6.14 SUMMARY

The system architecture enables us to see numerous opportunities for coordination and cost saving among projects that, at first glance, seem unrelated and that may be built in different time frames. Readers and transportation professionals who are involved in detailed projects are referred to the System Architecture document for further information.

SECTION 7
INSTITUTIONAL FRAMEWORK

The expansion of intelligent transportation systems in the Garden State Parkway Corridor is an extension of NJHA's role in transportation and of a series of ongoing projects in a broad program of moving goods and people. Much of the framework—the organizational structure, funding, legal basis, etc.—is already in place. Nevertheless, as the ITS program grows, both in geographical scope and complexity, that framework must also grow. The institutional issues presented in this section, therefore, represent issues to be considered. But they should not be viewed as barriers to implementing the projects identified in this plan.

Within the broad heading of "institutional framework" are the topical areas of: legal issues, contractual issues, and funding issues. Each of these warrants consideration for, in order to expand ITS in the corridor, it may be necessary to change some of the institutional practices of the NJHA and those entities that will work with the Authority on these projects.

7.1 LEGAL ISSUES

The projects envisioned in this Strategic Deployment Plan introduce legal issues that may not have been of concern to the Authority in the past. The interaction between the Authority and other public and private entities and the general public suggest that these issues need to be considered and that new practices added to those already in place. In many instances, the current practices will need only to be expanded to cover the new relationships.

While NJHA has always had working agreements with the localities through which the Parkway passes, the proposed projects cover not just the GSP but also the intersecting and parallel routes. Compatibility between equipment on and off the Parkway will require a strengthening of those agreements. Greater reliance upon local emergency services, summoned through a NJHA traffic operations center will create a focal point for some of these contacts.

At a grander level, the NJHA will intensify its relationship with TRANSCOM, with greater two-way communication than before. Along with a greater information exchange is likely to be a more significant emphasis on common procurement specifications and procedures. The Parkway will also become more closely wedded to the I-95 Coalition, creating connections not yet encountered.

The traffic operations center could conceivably be a microcosm of the legal interactions that NJHA will encounter with "sister" agencies. The TOC would likely be staffed not only with NJHA personnel but also state and local personnel from other agencies, public and private. Lines of authority and communication may need to be clarified as individual staffs seek to respond to requests from staff within their own agency, outside the TOC, and supervisory personnel not a part of their own agency. Similarly, the employment practices of the various agencies (e.g., work rules, hiring practices, training practices) will differ. Staff will need to adapt to this new work environment and NJHA, and other agencies, may need to make exceptions to their employment practices.

The proposed expansion of ITS will introduce new liability concerns, primarily because of the heightened awareness of the potential for litigation rather than from any new risks imposed by the projects. Liability generally remains with the driver who is responsible for the actions of his or her automobile and the choices that he or she makes. But when incidents occur on a diversion route, either to a traveler, or to the neighborhood through which he passes, litigants may pursue the Authority for its "deep pockets." Individuals may presume that information generated by the ITS projects carries a guarantee of accuracy and safety never suggested.

The prospect of private consultants and contractors, acting on behalf of the state in the construction, operations, and maintenance of ITS improvements, even if it is only disseminating information received from surveillance projects, may introduce a perceived, new line of risk. These contingencies should be addressed prior to implementation of the projects but should not prevent their implementation.

Sharing of resources will also mean sharing of procurement and with it a host of legal considerations. Prior to the passage of ISTEA, toll roads were not eligible for federal funds and so NJHA procurements were primarily internal matters. The 1991 legislation lifted that exclusion and the anticipated legislation will maintain the current status quo. The use of federal funds on the Parkway, therefore, should not present any new legal issues. However, the extension of ITS beyond the limits of the GSP right of way may result in common procurements between the state DOT and NJHA; differing procedures may need to be coordinated. Similarly, the introduction of public-private partnerships may place the Authority in a position in which a private entity makes a procurement on behalf of the Authority or can make a procurement for which the Authority is partially assessed. While private entities can frequently make purchases more quickly and even at a lower cost, they do not follow the "arm's length" and other procurement practices of a public agency. Requirement for low-bid procurement, multiple bidders, or public announcements of bid opportunities are not necessarily standard practice in the private sector. The first

procurements made under such an arrangement will be test cases unless some guidelines are established at the onset of the proposed ITS program.

One of the more dramatic areas in which public-private procurements may present an issue is with selection of a winning bid. Most public sector procurement requires that the lowest qualified bidder be awarded a contract. Bids which exceed the specifications are not encouraged because they frequently carry higher costs. Previous performance and preexisting relationships do not officially carry any weight in the selection process. In private procurements, however, offers of a better product for a slightly higher cost may be accepted. Similarly, private entities will often limit eligible bidders to those with which there is an established track record. The extent to which state procurement regulations must apply to private procurements will need to be considered.

At the opposite end of the spectrum is the concern that a rigid specification may limit eligible bidders to a number so small as to invoke antitrust action. Narrowly defined specifications, in restraint of trade are not permissible. Extension of the procurements beyond the public sector may invite a closer legal scrutiny than when only for certain public sector procurements.

Conflict of interest laws and regulations may also limit the ability of public agencies to engage in essentially design-build contracts. Using private partners to carry out public agency projects may be viewed as less than arm's length agreements and violate these laws. While such practices can have benefits, and because of those benefits are common on the private sector side, they violate the spirit of fair government practices and will need to be considered.

Public-private partnerships may also limit the pool of eligible bidders. The magnitude of some of the procurements envisioned under this program will be large. Smaller firms may not be able to compete with the larger firms. The public-private partnering would, therefore, limit competition and exclude small firms. Similarly, public agency disadvantaged business enterprise (DBE) participation requirements may not be compatible with such partnerships. While DBEs could work as subcontractor to larger, better established firms, DBEs could not compete directly and public agencies might not, therefore, meet their mandates to work with disadvantaged business enterprises.

Even partnerships between public agencies may require some discussion prior to making procurements. Each agency has rules and procedures which, while generally striving for the same objectives (i.e., fairness, increased competition, lowest cost to the public) may be different. One way to minimize conflicts is to authorize one agency to make the procurement under its rules rather than attempt a joint procurement. Agencies may even

take turns making the procurements so as not to burden one or the other. Discussions should take place, nonetheless, to ensure that one agency's rules do not invite legal challenges from another agency's potential bidder.

These same guidelines of establishing procedures "up front" would apply to most procurement situations. Advising potential bidders and the general public would also minimize concerns over antitrust violations and unfair bidding practices developing from "new procedures."

Privacy issues have become central as enhanced ITS features are implemented. While vehicle counting equipment and even video cameras have not raised many concerns, the potential for identifying individual movements through E-ZPass tags, and the exposure of personal financial information through E-ZPass records has caused some of the traveling public to express reservations about such systems. Commercial operations, for example, are afraid that the enhanced ability of the police to monitor individual vehicle movements may result in citations for violations of speed limits. Individuals who want to travel without others possessing the knowledge of where they are similarly concerned with surveillance capabilities. These fears are best met with clear explanations of the limited nature of the surveillance, the transient use of the data, the encryption of individual records, and the intended use of the information.

Safeguards of financial records must be both real and yet also cover perceived threats. Protections against billing accounts without the knowledge of E-ZPass holders and protections against outside interception of the data must be incorporated into the E-ZPass system. Here too, that there are such systems in effect today should help to gain acceptance of this system. As E-ZPass gains widespread acceptance and as the benefits of the system are demonstrated, privacy and security concerns should be reduced.

One feature of the proposed ITS program that is not new to the Garden State Parkway but may be new to some agencies that control roadways is that of new uses for highway right of ways. Communications companies, in particular, have entered into agreements to offer conduits or communications capacity in exchange for use of the highway right of way. Public agencies that previously offered easements but did not expect other than monetary payment, may need to adjust their thinking. Utility easements are not new; it is really only the form of payment—in-kind services—that is different from previous practices.

7.2 CONTRACTUAL ISSUES

The New Jersey Highway Authority operates the Garden State Parkway under a charter issued by the New Jersey legislature. That charter forms the basis for a contractual

relationship between the Authority and the bondholders who supplied the financial support for the road. The NJHA offers a reasonable rate of return on the bondholders' investment through establishing an appropriate toll level, collecting that toll, and disbursing the receipts. Anything that jeopardizes that cash flow risks challenge.

The relationship between the NJHA and its bondholders cannot be jeopardized, either through incurring costs that would affect the cash flow or through a breach of a contract. The Authority, therefore, cannot offer discounts on the tolls without compensating with an anticipated increase in toll paying traffic. Introducing unproven technologies to collect tolls and monitor traffic would violate the agreement between the Authority and the bondholders. New technologies must not only be proven but include safeguards that they will accurately assess vehicles and safely transfer funds without incurring higher processing costs than conventional toll collection operations.

The relative newness of the technology involved in electronic toll collection presents some contractual issues as well. In the private sector, firms may establish close working relationships with suppliers and consultants to assist them in learning about and implementing new technologies. These types of relationships may violate protections built into NJHA charter rules to protect bondholder investments. Changes in procurement regulations, to meet this problem, and the broader acceptance and familiarity with the E-ZPass technology should minimize this problem.

7.3 FUNDING ISSUES

Prior to 1991, toll roads were not eligible for federal funding and most projects, therefore, were funded solely by NJHA funds. The Intermodal Surface Transportation Efficiency Act of 1991 permitted the use of federal funds on toll roads. Federal funding, however, whether used on toll roads, local roads, or state roads, is requested from and passes through the state Department of Transportation. In addition, ISTEA made allocations to the states who then disbursed the money within the state. Federal funding passed to NJHA reduced the amount available for other uses. NJHA funding requests, therefore, had to follow state procedures in addition to its own procedures. It extended the need for environmental compliance and other state and federal regulations regarding requests for funds, procedures for procurement, and the use of the funds.

One possible impact of the use of federal funds could be to limit the ability to enter into unique agreements with private entities. In addition to the contractual limitations cited above, the federal regulations impose rules on who may receive federal expenditures and the manner in which such entities may be selected.

Perhaps the most important funding issue at this time is the uncertainty surrounding the future of federal funding. While there is general agreement that a new spending bill will be authorized, the overall levels, state allocation formulas, and specific categories that will be authorized are unknown. The next legislation will generally be similar to the last bill but details, which could specifically affect ITS spending, may be different.

ISTEA, and its successor, also add control of some spending to the metropolitan planning organizations. There are three such organizations in New Jersey two of which—one for the northern New Jersey area surrounding New York City and one in southern New Jersey are affected by this project. NJHA will need to become increasingly familiar with the MPOs' practices and personalities as these organizations represent a source of financial control and also inter-jurisdictional cooperation that may advance the projects proposed in this plan.

The next version of ISTEA will continue to promote the commingling of NJHA funds with other agencies' funding. Limiting spending to just NJHA funds, and dispensing with the control that comes from others' funds, will not be a possibility in the future.

7.4 CONCLUSIONS

None of the issues raised in this section suggest a significant problem for implementation of this early deployment program. There will need to be some studies conducted and some discussions held with organizations with which NJHA needs to collaborate. A public information program will be required to advise bidders, cooperating agencies, private entities, and the general public of the changed institutional environment in which ITS will be deployed in the corridor.

7.5 INTELLIGENT TRANSPORTATION INFRASTRUCTURE REPORT

7.5.1 Introduction

On January 10, 1996, Secretary Federico Pena announced a new Department of Transportation program entitled "Operation TimeSaver." This new program presented a national goal to build an Intelligent Transportation Infrastructure. The program was established to "implement the Intelligent Transportation Infrastructure in the 75 largest metropolitan areas within 10 years--to save time and lives and improve the quality of life for Americans everywhere."

The United States Department of Transportation created the Intelligent Transportation Infrastructure initiative in an attempt to alleviate the ever increasing strain on the nations

antiquated transportation infrastructure, and to increase the overall efficiency of the nations surface transportation system. The US DOT estimates that Americans will save up to 15 percent of their current travel time with the implementation of Intelligent Transportation Infrastructure.

This report will define what exactly Intelligent Transportation Infrastructure (ITI) is, and how the program relates to the Garden State Parkway Early Deployment Study. The report will discuss each of the twelve proposed Early Deployment projects and the ITI component with which each of the projects is related.

7.5.2 Intelligent Transportation Infrastructure (ITI)

Intelligent Transportation Infrastructure is the assemblage and joining of initial construction and existing transportation and communication components of large and small scale metropolitan areas. Existing systems such as Traffic Control, Freeway Management, Transit Management, Incident Management, Electronic Fare Payment, Electronic Toll Collection, Regional Multi-modal Traveler Information Centers, Railroad Grade Crossings and Emergency Management, will be integrated to establish more efficient means of surface transportation.

Most, if not all, of the 75 major metropolitan areas have some form of these nine projects already in place, or will be in place in the near future. It is the goal of ITI to combine the systems resources, and create significant benefits from systems that are already in place, and have not met there useful potential.

The integration of these existing nine systems, will allow for each of the individual systems to achieve more productivity and efficiency within its own environment, and allow information to flow among all of the systems, resulting in a communication and information network geared toward creating a transportation infrastructure, in turn saving Americans time and money.

To begin implementing the system, the government has decided to start by installing model deployments in the large scale metropolitan areas. From these models, other large and small scale metropolitan areas can observe the overall effectiveness of the program, which will help the small scale areas implement a transportation infrastructure to their area.

7.5.3 The National Need for ITI

The National transportation infrastructure is in great need of improvement and expansion. The US DOT estimated that the nation would need a 34 percent increase in highway capacity, just to remain constant with the current growth in vehicle miles traveled. The ITI initiative will establish a more efficient means of managing the existing surface transportation system, allowing for greater capacity. When comparing costs of installing

new lane miles versus more efficient management of the existing miles, it is evident that efficient management is a sound economical and efficient approach.

With the increase in congestion among our existing arterial roadways, and with expansion limits reaching capacity, a need has arisen to better manage the existing facilities that are currently have in operation.

As previously mentioned, the current plan is to deploy the program to the 75 largest metropolitan areas within the next ten years. This strategy will serve 50 percent of the nations population within the initial 10-year deployment.

7.5.4 ITI Benefits to the Average Citizen

ITI will provide emergency vehicles improved access times to locations that require their assistance. This would be accomplished through the "shared" information plan of ITI. The incidents can be located at a quicker rate through the use of Global Positioning System technology. Emergency response vehicles would be able to locate the quickest route to an emergency facility through the use of traffic delay information.

With the integration of shared transportation information, trip planning for commuters will be streamlined, creating a more informed commuter. Drive times would be easily accessible, and allow for efficient planning by the commuter. Bus scheduling information would be obtainable in real-time. Bus routes experiencing delay would be identified, with alternatives and estimated arrival times made available to the commuter.

As previously mentioned, the ITI initiative will create a 15 percent reduction in overall travel time to the average citizen. If a commuter averages approximately 90 minutes of drive time per day, the new program will save the commuter four to five hours a month. This computes to a two-day savings per year.

7.5.5 System Overview

The nine subsystems incorporated into the ITI program which were mentioned above, are in many cases already installed in most of the larger metropolitan areas, and many of the smaller metropolitan areas as well. The systems and there advantages are;

- **Traffic Signal Control Systems** - Provides coordinated traffic signal control within an entire metropolitan area. This system reduces travel time by establishing traffic progression patterns, and ultimately creating an efficient timing scheme for traffic flow.

- **Regional Multimodal Traveler Information System** - This system is a data collection package that receives, processes and distributes current travel

data. The process data is then supplied to travelers for their usage through a variety of channels.

- **Freeway Management System** - This system monitors real-time traffic information, processes the data, then the data is utilized by operations personnel to modify the freeway/roadway control devices to establish a more efficient travel environment.

- **Transit Management System** -This system supplies bus location data to the bus operator back at the operations center. The information is processed by the operator and computer programs to derive strategies for reducing delay.

- **Incident Management Programs** - A program designed to facilitate the detection and rapid response to roadway incidents. Real-time data is collected and processed in order to respond with the correct equipment in a relatively short amount of time.

- **Electronic Fare Payment System** -This system utilizes equipment installed in vehicles and along roadways to collect transit fees, parking fees, and establishes a single-pay method of bill payment where periodic fees can be paid on a lump sum basis.

- **Electronic Toll Collection System** - This system incorporates equipment inside of vehicles and along roadways to expedite toll collection activities by eliminating the stopping of the vehicles. It also eliminates "exact fare" problems which quite often occur.

- **Railroad Grade Crossing** - This system monitors train traffic flow through the use of real-time data collection. With this information, highway-rail intersections can be controlled through interaction between the traffic control centers and the rail operations center.

- **Emergency Management Services** - This system coordinates emergency services within a multi-jurisdictional area, establishing a more efficient relationship amongst support services located in jurisdictions that share a boundary.

Under the ITI initiative, information from each of these systems would be integrated, allowing other systems to benefit from each of the other system's collected data.

7.5.6 ITI and the Garden State Parkway Early Deployment

With the Federal Government's focus on integration of the Intelligent Transportation Infrastructure, state and local officials are being encouraged to "buy smart," by purchasing transportation related systems that would be capable of sharing data with the other nine components of the Intelligent Transportation Infrastructure. This challenge set forth by the federal government suggests that the metropolitan areas begin their transition to full integration of systems by concentrating on integrating existing components within the jurisdiction. The Model Deployment Initiative in the New York metropolitan area is an example of such a strategy. The secretary stressed that all communities have at least some form of traffic signal system, and that this would be an excellent starting point for the smaller cities.

Following is a description of each of the projects contained within the Garden State Parkway Early Deployment Study, and each of the project's relationship with the distinct components of the Intelligent Transportation Infrastructure initiative. As shown in Table 7-1 the twelve projects proposed for the Early Deployment Study satisfy a majority of the nine components of the Intelligent Transportation Infrastructure. The projects are detailed as follows:

Traffic Monitoring with CCTV & Detector Systems- The installation of CCTV cameras and detector systems satisfies several of the nine components of the ITI initiative. *Freeway Management, Transit Management, Emergency Management* and *Incident Management* will be provided through the use of the CCTV and Detector systems, and will contribute valuable data to a *Regional Multimodal Traveler Information System.*

Advertise Emergency Assistance Phone Numbers with Highway Signs- *Incident Management* and *Freeway Management* will be partially established with the installation of these signs. In the event of an incident, motorists will be encouraged to utilize the phone numbers.

Collect Travel Time Data in the Parkway Corridor- *Regional Multimodal Traveler Information*, *Freeway Management*, and *Incident Management* will be established through the use of the E-ZPass system. With the entire length of the Parkway outfitted with the system, monitoring and management of travel time conditions is achieved, as well as *Transit Management.*

Process and Disseminate Real-time Travel Data- Once the E-ZPass system is in place, the collected data will be used to establish better travel time scenarios through *Freeway Management, Transit Management, Incident Management, Emergency Management* and contribute valuable travel time information to a *Regional Multimodal Traveler Information System.*

Expand VMS/HAR Systems- With the installation of VMS and HAR, *Freeway Management* and *Incident Management* as well as *Emergency Management* and *Transit Management* can be conveyed to all Parkway travelers. The two systems are essential to quality communication from operations personnel to vehicles on the Parkway.

Establish a Parkway Home Page with Real-time Traveler Information- A Parkway web page is another essential communication tool that can be established at a relatively low cost. By posting all related transportation data, the page will aid in *Regional Multimodal Traveler Information System*, *Freeway Management*, *Incident Management*, and can notify travelers of *Traffic Signal Control* problems.

Upgrade the Parkway Traffic Operations Center- Upgrading the Traffic Control Center would allow many new traffic control and communication systems to be installed. It would allow for the creation of a *Regional Multimodal Traveler Information System* and establish an operations center for *Freeway Management* and *Incident Management.*

Enhance Management of Park & Ride Lots with ETTM Technology- In conjunction with the E-ZPass system, parking fees for the park and ride lots will be collected through the *Electronic Fare Payment System* or *Electronic toll Collection System.*

Operate a Bus Location System with ETTM Technology- The installation of the E-ZPass system will also allow for detailed tracking of individual buses along the Garden State Parkway, and establish the basis for a *Freeway Management System* and a *Transit Management System.*

Operate a Stop-on-Demand Bus Service Through Park & Ride Lots - This bus notification system will be based on the E-ZPass system, and also provide data and information for a *Transit Management System* and a *Freeway Management System.*

Display Real-time Transit Schedule Information at Park & Ride Lots- By providing this real-time information to the bus traveler, it will inform the passenger of scheduling information and changes through the use of a *Transit Management System and Regional Multimodal.*

Operate Information Kiosks at the Service Areas (Private Sector)- By establishing these kiosks at service areas, a wealth of useful information can be passed on to the Parkway traveler, again establishing *Freeway Management* and *Incident Management* capabilities and provide input for a *Regional Multimodal Traveler Information System.*

7.5.7 Summary and Conclusion

Intelligent Transportation Infrastructure is the assemblage and joining of transportation systems for the use of sharing data. With the sharing of this data, each individual transpiration system will be able to operate more efficiently within it's own system, and contribute valuable data to other transportation systems.

It is clear that all twelve proposed projects for the Garden State Parkway Early Deployment Study are in agreement with Secretary Pena's ITI initiative. In fact, a majority of the twelve projects satisfy more than one of the nine components to the ITI initiative. This compliance demonstrates New Jersey Highway Authority's willingness and dedication to adhering to the United States Department of Transportation's planning to alleviate current transportation problems.

Table 7-1

SHORT-TERM PROJECTS AND THE ITI

PROJECT	ITI COMPONENTS								
	Traffic Signals Systems	RMTIS*	Freeway Manage-ment	Transit Manage-ment	Incident Manage-ment	Electronic Fare Payment	Electronic Toll Collection	Railroad Grade Crossing	Emergency Manage-ment
Traffic Monitoring - CCTV and Detectors Systems		✔	✔	✔	✔				✔
Advertise Emergency Assistance Phone Numbers			✔		✔				✔
Collect Travel Time Data in Parkway Corridor		✔	✔	✔	✔				
Process and Disseminate Real-time Traffic Data		✔	✔	✔	✔				✔
Expand VMS/HAR Systems			✔	✔	✔				✔
Establish Parkway Home Page w/ Real-time Info.	✔	✔	✔	✔	✔				
Upgrade the Parkway Traffic Operations Center		✔	✔	✔	✔				✔
Enhance Management of Park & Ride lots w/ ETTM				✔		✔	✔		
Operate a Bus Location System with ETTM			✔	✔					
Operate A Stop-on-Demand Bus Service @ Park & Rides			✔	✔					
Display Real-time Transit Schedule		✔	✔	✔					
Operate Information Kiosks at Service Areas		✔	✔		✔				

*RMTIS = Regional Multimodal Traveler Information System

BIBLIOGRAPHY

1. ITS Early Deployment Planning Study
***Phase One Technical Memoranda*:**

- ***Problems, Needs and Systems***
- ***Institutional Framework and Consensus Building***
- ***User Service Objectives and Regional Transportation Goals***
- ***Performance Criteria***

Prepared by Frederic R. Harris, Inc., March 1997.

2. ITS Early Deployment Planning Study
Final User Services Plan

Prepared by Frederic R. Harris, Inc., March 1997.

3. ITS Early Deployment Planning Study
Functional Requirements Technical Memorandum

Prepared by Frederic R. Harris, Inc., March 1997.

4. ITS Early Deployment Planning Study
Technology Assessment Report

Prepared by Frederic R. Harris, Inc., June 1997.

5. ITS Early Deployment Planning Study
Phase 2 Architecture Development

Prepared by Lawrence A. Klein, Ph.D. for
Frederic R. Harris, Inc., October 1997.

6. ITS Early Deployment Planning Study
Implementation and Operations Plan

Prepared by Frederic R. Harris, Inc., October 1997.

TRAFFIC MONITORING WITH CCTV & DETECTOR SYSTEMS

DESCRIPTION:

The objective of this project is to provide the NJHA Traffic Operations Center (TOC) personnel with improved information about traffic conditions on the Parkway. CCTV systems would show the actual conditions at locations where accidents, incidents and other delays most frequently occur. Detector systems would measure traffic volumes at periodic intervals along the Parkway. The TOC personnel would use this information to help mobilize the resources to remove capacity constraints.

This project has two parts. The first is the installation of additional CCTV monitoring equipment at various locations along the Parkway. These CCTV units would be installed in accordance with previously determined priorities. This first installation would include the installation of the monitors at the NJHA's Traffic Operations Center. Follow-on projects would extend the camera coverage to areas with lower priorities.

The second part of the project would install detector systems for monitoring traffic flow on the Parkway. These detectors would be installed across all of the highway lanes at 5 to 10 mile intervals. The primary function of these detectors are to determine traffic flow volumes. Spot speeds would be estimated using detector occupancy rates and assumed vehicle lengths. The detector technology used for this system could be loop detectors, but might also be a non-invasive technology that is less expensive to install and maintain in heavy traffic volumes areas. Since the detectors would not be installed at closely spaced intervals, their placement is flexible, and can take advantage of existing overhead sign structures and overpasses.

(Note: The installation of E-ZPass readers at closer spacing would be used for the calculation of average travel times, average speeds and for incident detection between tag readers. The deployment of these tag readers is described in another project.)

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
●	**Reduces Incident Related Delay**	**A major benefit of this project will be reductions in incident-related delay, measured in vehicle-hours of delay. By reducing the average incident response and clearance times, travel delay can be saved for each vehicle caught in incident-related congestion. This benefit is accrued to all Parkway travelers. The net result for the entire Parkway system will be very significant.**
○	**Improves Safety**	**By detecting and verifying roadway incidents more quickly, the incident response time and overall incident duration will be reduced. This will indirectly result in: improved motorist safety due to more prompt medical, fire, and police attention; and a reduction in secondary accidents.**
○	**Reduces Operating Costs**	**Installation of CCTV cameras will reduce the number of "Gone on Arrival" motorist assistance calls because needs for assistance can be visually verified by Operators at the Parkway traffic management center prior to dispatching an assistance vehicle.**
○	**Promotes Better Use of Parkway Resources**	**CCTV cameras can be used to assess when motorists should use the inner or outer roadways, and when traffic messages identifying congested conditions should be removed.**
	Indirect Benefits	
●	Provides Data for Planning and Operations	Deployment of additional CCTV cameras and detectors along the Parkway will provide current and historical data to support other Advanced Traffic Management System services. For example, traffic volume data can be used to evaluate existing activities and assist in planning new projects.
○	Reduces Environmental Impacts	Reductions in vehicle emissions will be realized due to reductions in incident-related congestion.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

CCTV

It was assumed that the space requirements at the Traffic Operations Center (TOC) for CCTV equipment will not be a problem, and that a functional layout will be obtained from current or future space occupied by the Traffic Operations Center.

It was also assumed that the yearly maintenance to the CCTV system alone would be around seven percent of the initial field equipment costs. This estimated percentage rate may vary, depending on actual conditions.

The project cost range, detailed on the Project Cost Summary sheet, shows a low-end value that would reflect a "bare minimum" system. The higher-end cost would reflect the installation of a complete system with all of the supporting equipment.

The estimated cost for a 31 camera system was calculated to be $2,554,000. With variables such as communications, unit mounting, and equipment costs, a cost range from $1,711,000 to $2,554,000 was derived. See cost estimate on following page.

Detector System

For the basis of cost estimating, system loop detection was used as the type of detection that will be used for this project. It was assumed that detection stations will be installed every five miles along the entire length of the Parkway. Additional stations will be placed in areas that contribute or relieve a significant amount of traffic to and from the Parkway. Therefore it was determined that 34 detector stations would be needed for the main-line of the Parkway, and an additional 12 stations would be used to delineate entering and exiting traffic flow among interchanges. Each station will consist of a loop in each lane of traffic, for each direction.

It was determined that approximately 15-25 percent of all loops will need replacement within the first year of operation, depending on the quality of installation and the surrounding environment, such as weather, traffic flow, etc. It was decided that loops installed on the Garden State Parkway would need to be maintained on somewhat of an average basis, or that approximately 18 percent of the loops that were initially installed would need replacement. Therefore, a first year maintenance cost of around 18 percent of the initial total loop installation cost was used.

The estimated project cost-range is dependant on the number of loops that will need to be replaced within the first year of operation. The range will also depend on the amount of "non-main line" detector stations the Parkway decides to have installed. A minimum of 12 detector stations was estimated to be installed off of the main-line, but this would be a minimum, and the system would benefit from the use of several more non main-line detector stations.

The estimated cost for this project was calculated to be $1,840,000. With variables such as type of detection, maintenance of traffic costs, and equipment and labor costs, a cost range of $1,238,000 to $1,840,000 was derived. See cost estimate on following pages.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Traffic Monitoring with CCTV & Detector Systems

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Source	Assumptions
1. CCTV System						
Central Equipment						
CCTV Central Equipment	LS	$125,100	1	$125,100	I-64 Bid	
CCTV Computer	LS	$10,000	1	$10,000	Estimate	
CCTV System Software	LS	$100,000	1	$100,000	Estimate	
Switcher/Controller	EA	$20,000	1	$20,000	Estimate/Harris	
Operator console	LS	$35,000	2	$70,000	I-64 Bid	
Video Projection Screen	EA	$35,700	1	$35,700	I-64 Bid	
Equipment Rack	EA	$2,500	2	$5,000	Estimate	
Titler	EA	$15,000	1	$15,000	Penn-Lincoln Estimate	
Video CODEC	EA	$7,500	1	$7,500	Penn-Lincoln Estimate	
Modems - Field	EA	$1,500	31	$46,500	Hampton Signal System	
Modems - Central	EA	$1,500	31	$46,500	Hampton Signal System	
Video Dist. Amplifier Assem	EA	$500	31	$15,500	Penn-Lincoln Estimate	
19" Monitor	EA	$1,400	16	$22,400	Estimate	
Video Cassette Recorder	EA	$600	1	$600	Estimate	
Subtotal				$519,800		
Camera Locations						
Camera Assembly	EA	$14,500	31	$449,500	Hampton Signal System	
High Power Zoom Lens	EA	$3,270	31	$101,370	Route One System	
Camera Controller	EA	$4,550	31	$141,050	Hickory NC Bid	
CCTV Camera Pole/Found	EA	$19,000	31	$589,000	Hampton Signal System	Minimum cost for new poles
Subtotal				$1,280,920		
Communications						Existing Com back bone in place
Tie in to back bone	EA	$12,500	31	$387,500	Estimate	
Subtotal				$387,500		
Operations and Maintenance						
Operations	YR	$1,712,000	0.14	$239,680		
Maintenance	YR	$1,800,720	0.07	$126,050		7% of field equipment costs
Subtotal				$365,730		
Project Total				**$2,553,950**		

December 22, 1997

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Traffic Monitoring with CCTV & Detector Systems

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Source	Assumptions
1B. Detector System						
Central Equipment						
Computer	LS	$11,500	1	$11,500	Estimate	
Software	LS	$75,000	1	$75,000	Estimate	
Server interface card	EA	$200	1	$200	Estimate	
Modems	EA	$900	2	$1,800	Hampton Signal System	
Subtotal				$88,500		
Detector Station - Main						
6'x6' Loops - 6 per	EA	$4,500	34	$153,000	Estimate/Harris	6 loops per station
Amplifiers - 3 per	EA	$720	34	$24,480	I-64 TMS	6 loops per station - 2 loops per amp
Lead-in cable/station	LS	$650	34	$22,100	Rt. One Estimate	For each 6
Cabinet	EA	$3,750	34	$127,500	Syracuse Bid	
Modems	EA	$900	34	$30,600	Hampoton Signal System	
Power - Hook-up	EA	$1,600	43	$68,800	Estimate/Harris	
Maintenance of traffic	EA	$4,700	68	$319,600	Estimate	Each station - each direction
Subtotal				$746,080		
Detector Station - Side						
6' x 6' Loops - 2 per	EA	$3,750	12	$45,000	Estimate/Harris	
Amplifiers - 1 per	EA	$240	12	$2,880	I-64 TMS	
Lead-in cable/station	EA	$500	12	$6,000	Rt. One Estimate	
Cabinet	EA	$3,750	12	$45,000	Syracuse Bid	
Modems	EA	$900	12	$10,800	Hampton Signal System	
Power - Hook-up	EA	$1,600	12	$19,200	Estimate/Harris	
Maintenance of Traffic	EA	$3,200	12	$38,400	Estimate	
Subtotal				$167,280		
Miscellaneous						
Trenching	EA	$1,100	46	$50,600	Estimate	Each Location
Conduit	EA	$450	46	$20,700	Estimate	Each Location
Splice Boxes	EA	$610	46	$28,060	Estimate	Each Location
Subtotal				$99,360		
Communications						
Tie-in to existing back bone	EA	$12,500	35	$437,500	Estimate	
Subtotal				$437,500		
Operations and Maintenance						
Operations	YR	$1,712,000	0.08	$136,960		
Maintenance	YR	$913,360	0.18	$164,405		18 percent of initial installation cost
Subtotal				$301,365		
Project Total				**$1,840,085**		

December 22, 1997

ADVERTISE EMERGENCY ASSISTANCE PHONE NUMBERS WITH HIGHWAY SIGNS

DESCRIPTION:

This project would let the public know how to report incidents and request assistance through the installation of static signs displaying the numbers to be called when there is an emergency, or a disabled vehicle. It would complement the systems that receive these calls, identify the location of the problem, and dispatch assistance. These signs would also reinforce the message to motorists that "You're Never Alone on the Parkway."

This project would resolve several issues including:

- selecting the telephone number to use for emergency calls,
- deciding which organization would answer the disabled vehicle calls,
- selecting the telephone number to use for disabled vehicles,
- obtaining agreements with the cellular telephone service providers to ensure that "good Samaritans" would not be billed for these calls,
- developing a design for these signs and their installation, and obtaining approvals from the agencies that are concerned, and
- developing guidelines for the locations at which these signs would be installed. (i.e., on the entrance ramps, a few hundred feet downstream of each on-ramp, or at periodic intervals on the mainline.)

The project would also be responsible for the design of any necessary enhancements to the telephone system and the physical facilities (such as desks, work areas, etc.) at the locations receiving these calls.

BENEFITS:

Major/ Minor	Benefit	Description
Direct Benefits		
●	Reduces Incident Related Delay	The installation of emergency assistance signs and dedicated phone numbers for requesting help will result in reduced clearance times and less incident related delay.
●	Improves Safety	By detecting and verifying roadway incidents more quickly, the incident response time can be reduced. This will result in improved motorist safety due to more prompt medical, fire, and police attention; and reduced secondary accidents.
●	Improves Traveler Satisfaction & Sense of Security	Travelers on the Parkway will experience a higher sense of security by having rapid access to emergency assistance. This is an important step in reinforcing the Parkway's message "You're Never Alone on the Parkway".
Indirect Benefits		
○	Reduces Environmental Impacts	Reductions in vehicle emissions will be realized due to reductions in incident related congestion.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

It was determined that the estimated size of sign for this project would be approximately 4ft. by 8 ft.. Considering the amount of text that is involved with each message incorporated on each of the signs, and the speeds at which these signs are to be read, a relatively large sign is definitely needed. A 4ft. x 8ft. sign would be a sufficient minimum necessary to supply large enough text for the designated messages.

The costs derived for the installation of the emergency-number signs includes minimal costs for maintenance of traffic during installation. It is assumed that these signs can be installed with little affect to traffic flow. If for some reason a lane would need to be closed to install one of these signs, then of course the maintenance of traffic cost estimate would be much higher. The estimate also assumes that the communications for this project will be conducted and centralized from the new control center.

The estimated project cost-range is dependant on two items. As previously mentioned, if traffic flow must be disrupted in order to install the signs, than a significant amount of additional money would be needed. If the governing bodies decide to go with a larger and more intricate sign, than this too would significantly escalate the cost for each in-place sign.

The project cost estimate totaled $126,000. Considering variables such as final sign size, mounting standards, and final location of signs, a cost range from $76,000 to $126,000 was derived. See cost estimate on following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Advertise Emergency Assistance Phone Numbers with Highway Signs

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
2. Signs					
Sign Installation					
Signs	EA	$950	17	$16,150	
Posts - 2 per sign	EA	$275	34	$9,350	
Installation	EA	$250	17	$4,250	
Maintenance of Traffic	EA	$800	17	$13,600	
Subtotal				$43,350	
Central Equipment					
Communications	EA	$5,000	1	$5,000	
Work station	EA	$9,000	1	$9,000	
Subtotal				$14,000	
Operations& Maintenance					
Operations	YR	$1,712,000	0.03	$51,360	
Maintenance	YR	$17,000	1	$17,000	Includes allocation for parts
Subtotal				$68,360	
Project Total				**$125,710**	

December 22, 1997

COLLECT TRAVEL TIME DATA IN THE PARKWAY CORRIDOR

DESCRIPTION:

This project would gather travel time data from individual vehicles equipped with E-ZPass tags and would use these data to estimate average travel times between tag readers. The NJHA's Traffic Operations Center (TOC) personnel would use the raw travel time data to monitor traffic flow and detect possible incidents on the Parkway.

E-ZPass tag readers may also be installed on other roadways in the corridor. These tag readers would be installed in keeping with the priorities established by the NJDOT for its MAGIC program.

Where appropriate, the data from these other readers could be carried back to the appropriate agency over the NJHA's fiber optic backbone, to the (TOC), or another point where the NJHA's fiber can interface with an NJDOT communications hub.

This project would identify the specific locations where the tag readers would be installed, the design of the communications system, and identify the hardware and software required by this system in the field and at the TOC.

BENEFITS:

Major/ Minor	Benefit	Description
		Direct Benefits
●	Reduces Incident Related Delay	A major benefit of extending the TRANSMIT incident detection system will be reductions in incident-related delay by reducing the average incident response time. In conjunction with upgrades to the traffic operations center, travel delay can be saved for each vehicle caught in incident-related congestion. This benefit is accrued to all Parkway travelers.
○	Reduces Recurring Delay	The travel time data collected by E-ZPass readers may help to reduce recurring congestion if it is disseminated to travelers who drive during peak hours. Data collected as a result of implementing this project will support the systems developed under Project #4: Develop Systems to Process and Disseminate Travel Time Data.
○	Improves Safety	By detecting Parkway incidents more quickly, the incident response time and overall incident duration can be reduced. This will result in improved motorist safety due to more prompt medical, fire, and police attention; and reductions in secondary accidents.
○	Promotes Better Use of Parkway Resources	The extension of the TRANSMIT system will make better use of Parkway resources by using the travel time data to show travelers that the Parkway is the fastest route to their destination.
		Indirect Benefits
●	Provides Data for Planning and Operations	Deployment of additional E-ZPass toll tag readers along the Parkway will provide current and historical travel time data to support other Advanced Traffic Management System services and provide data for project planning.
○	Reduces Environmental Impacts	Reductions in vehicle emissions will be realized due to reductions in incident-related congestion.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

In order to achieve a relatively high degree of travel data accuracy, the manufacturer of E-ZPass recommends that their detection equipment be installed at 1.5 mile intervals. It was estimated that a total of 114 readers would need to be installed along the Parkway mainline in order to maintain this design criterion. An additional 10 readers were designated to be installed in the Park and Ride lots as well. E-ZPass readers installed in the lots will establish methods data collection for other projects outlined in this report.

The $37,513 for computer hardware includes such items as a standard Sun station, hard drive, CD-rom, two separate modems, UPS, 19" monitor, and other miscellaneous related hardware needed to operate the E-Zpass system. This cost is derived from actual purchases made on a project in 1996, so this price may have come down a significant amount. This can be said for the cost for the readers as well. It is assumed that the 1996 price of $37,800 per reader has come down some amount, and is reflected in the cost range found on the project cost summary sheet.

It was estimated that not all of the readers would need to be mounted to a new, dedicated structure, and could simply be mounted to an existing structure, ie, signs, overpasses, etc. It was estimated that 20 percent of the readers could use existing structures for support. Because the units have to be stationed at exact intervals of 1.5 miles, this limits the amount of flux in reader site locations, as well as the amount of readers that could utilize an existing structure for mounting purposes.

This project was estimated to cost $7,185,000. However, considering the substantial variables involved, such as cost of equipment, mounting conditions, communications, and final configurations, a cost range of $4,118,000 to $7,185,000 was derived. See cost estimate on following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Collect Travel Time Data in the Parkway Corridor

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
3. E-Z Pass Data					
Data Processing (TOC)					
Computer hardware	LS	$37,513	1	$37,513	
Server software	LS	$77,421	1	$77,421	
Server Interface Card	EA	$200	1	$200	
Subtotal				$115,134	
Remote Work station					
Computer Hardware	LS	$10,777	1	$10,777	
Computer Software	LS	$3,415	1	$3,415	
Workstation	LS	$9,000	1	$9,000	
Subtotal				$23,192	
Collection Equipment					
E-ZPass Readers/Equip.	EA	$37,800	124	$4,687,200	Reader, equip, cabinet, transceiver
Mounting	EA	$600	91	$54,600	
Junction box	EA	$250	124	$31,000	
Cabinet foundations	EA	$225	114	$25,650	
Subtotal				$4,798,450	
Communications					
Tie-in to back bone	EA	$12,500	124	$1,550,000	Use existing fiber optic back bone
Subtotal				$1,550,000	
Operations and Maintenance					
Operations	YR	$1,712,000	0.1	$171,200	
Maintenance	YR	$527,000	1	$527,000	Approx 12 percent of field electronics
Subtotal				$698,200	per year
Project Total				**$7,184,976**	

December 22, 1997

PROCESS AND DISSEMINATE REAL-TIME TRAVEL DATA

DESCRIPTION:

This project complements the deployment of the E-ZPass tag readers previously described by preparing estimates of the travel time and average speed that can be disseminated to the general public. The data would also allow motorists with more sophisticated equipment to determine their estimated travel times to specific destinations in the Parkway Corridor. The average travel time data would be disseminated through two ways. It would be transmitted to TRANSCOM where it would be combined with data from other agencies and disseminated to the public through the ISPs (information service providers) and other mechanisms. The average travel time data would also be converted to speed ranges and this information would be used to update a graphic display on the Parkway's web page. (The development of a home page for the Parkway is described in another project.)

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
○	Reduces Incident Related Delay	Accurate travel time estimates made available to motorists is expected to resultin some travelers detouring around the congested area and marginal reductions in incident-related delays.
○	Reduces Recurring Delay	Travel time data may encourage some travelers to shift their trips to time periods when their overall travel time is reduced.
●	Improves Traveler Satisfaction & Sense of Security	Providing travel time data to Parkway travelers is expected to enhance customer satisfaction by helping customers avoid travel during congested conditions.
●	Promotes Better Use of Parkway Resources	Travelers who use the travel time data to determine the best time for their trip will help reduce the Parkway's peak hour factor.
	Indirect Benefits	
○	Reduces Environmental Impacts	Trips that are shifted to less congested time periods will be made at faster speeds which produce lower levels of pollution.
○	Shifts Travel to Less Congested Time Periods	Travel time data may encourage some travelers to shift their trips to time periods when their overall travel time is reduced.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

The cost estimate for this project was derived with the assumption that all data collection devices, such as loop detection and E-ZPass detection would be in place, and therefore costs associated with the installation and maintenance of data collection equipment was disregarded in this particular project cost estimate.

The project cost ranges from a minimum of approximately $120,000 to a ceiling of around $225,000. The cost estimate details the minimum costs necessary to maintain a data-analysis program. Cost increases would be incurred if the extent of the analysis intensified, and the number of personnel involved with the actual analysis was increased. See cost estimate on following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Process and Disseminate Real-time Travel Data

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
4. Travel Time Data					
Central Equipment					
Hardware	EA	$11,500	1	$11,500	
Software	EA	$74,000	1	$74,000	
Server Interface Card	EA	$200	1	$200	
Modem	EA	$900	2	$1,800	
Subtotal				$87,500	
Operations and Maintenance					
Operations	YR	$1,712,000	0.06	$102,720	
Maintenance	YR	$87,500	0.07	$6,125	7 percent of initial installation
Subtotal				$108,845	
Project Total				**$196,345**	

December 22, 1997

EXPAND VMS/HAR SYSTEMS

DESCRIPTION:

The objective of this project is to inform travelers of traffic conditions so that they can determine whether to stay on the Parkway or divert to an alternate route. The data describing traffic flow on the Parkway and alternate routes would be collected through other projects. This project provides the devices that would be used to give this information to travelers on the Parkway, and travelers approaching the Parkway on major arterials.

The existing VMS and HAR systems in the Parkway corridor would be supplemented with additional units installed as part of this project. The project would determine the exact locations for these devices, and the supporting equipment required at the NJHA Traffic Operations Center.

BENEFITS:

Major/ Minor	Benefit	Description
Direct Benefits		
●	Reduces Incident Related Delay	En-route motorists in the Parkway corridor can be informed about accidents and construction related delays through the use of Variable Message Signs (VMS) and Highway Advisory Radio (HAR) on the Parkway and on key roadways which feed the Parkway.
○	Improves Safety	A minor safety benefit will be realized by giving motorists messages that warn of hazardous roadway conditions during snow and ice storms, hurricane evacuations, etc.
●	Improves Traveler Satisfaction & Sense of Security	Accurate and timely messages keep the motorist informed about delays and hazards and eliminate some of the frustration associated with encountering unexpected delays. Similarly, in inclement weather conditions, the traveler's sense of security can be heightened by providing current information about potentially hazardous pavement and roadway conditions.
Indirect Benefits		
○	Reduces Environmental Impacts	Any reductions in delays will result in reductions in vehicle emissions.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

VMS

It was estimated that a total of 25 new Variable Message Signs would be installed in this project. The sign type would be fiber-oriented, and in most cases will be mounted to a new overhead sign structure. If a different type of support structure is used, or an existing structure is used at a portion, or all of the sign locations, the overall project cost will be significantly modified, and in most cases greatly reduced.

The cost for VMS's is derived with the assumption that a new software package will be needed to operate the 25 new signs. This total cost for software might be reduced if any existing software currently used for the Parkway can be modified to control a portion of the new signs.

HAR

It was estimated that a total of six new Highway Advisory Radio (HAR) sites would be installed for this project. It was also determined that there would be four flashing advisory signs, two in each direction, at each of the HAR locations.
Again, if existing equipment and software can be utilized to some extent, this would reduce the overall total project cost significantly. If the number of VMS or HAR sites changes, obviously this would greatly affect the final project cost estimate as well.

Training for the operation and maintenance of the additional HAR sites will not be necessary. Since there is an existing system already in place, additional personnel needed to operate and maintain the new HAR sites will be educated in-house, with no direct fees for external training.

The estimated costs for the two portions of this project totaled $4,822,000. Considering variable such as mounting structures, communications links, final equipment locations, and cost of equipment, a cost range of $2,923,000 to $5,363,000 was derived. See Cost estimates on the following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Expand VMS/HAR Systems

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
5. VMS/HAR					
VMS					
Signs	EA	$115,000	25	$2,875,000	OH structure - 3 line/18" letter Ht.
Cabinets	EA	$3,145	25	$78,625	
Central Software	EA	$60,000	1	$60,000	Existing in place
Computer	EA	$11,500	1	$11,500	
Fiber Modem - field	EA	$900	25	$22,500	
Fiber Modem - Central	EA	$900	25	$22,500	
Server Interface Card	EA	$200	1	$200	
Subtotal				$3,070,325	
Communications					
Tie in to Back bone	LS	$12,500	31	$387,500	
Subtotal				$387,500	
HAR					
Assembly	EA	$66,800	6	$400,800	
Control Cabinet	EA	$3,000	6	$18,000	
Flashing Sign Assembly	EA	$19,000	16	$304,000	4 per HAR site - 2 each direction
Central Computer	EA	$11,500	1	$11,500	
Software	EA	$125,000	1	$125,000	
Subtotal				$859,300	
Operations and Maintenanc					
VMS Operations	YR	$1,712,000	0.09	$154,080	
VMS maintenance	YR	$3,070,325	0.05	$153,516	5% of field equipment cost
HAR Operations	YR	$1,712,000	0.09	$154,080	
HAR maintenance	YR	$859,300	0.05	$42,965	5% of field equipment cost
Subtotal				$504,641	
Project Total				**$4,821,766**	

December 22, 1997

ESTABLISH A PARKWAY HOME PAGE
WITH REAL-TIME TRAVELER INFORMATION

DESCRIPTION:

This project is intended to show traffic conditions to travelers before they begin their trips. Through maps showing average speed, and images from the CCTV cameras, travelers would be able to assess the best route, and departure time. The home page would also contain other information which can encourage travelers to use the Parkway, shift some trips to less congested time periods, and use the multi-modal facilities available in the Parkway corridor.

The home page on the Internet would present static and real-time information on traffic and travel on the Parkway. Static data would include information such as the best exits for popular destinations (Atlantic City, Great Adventure, Cape May beaches, etc.); locations of service plazas and the services available; locations of park and ride lots and the connecting bus services that are available from them. Separate sections of the web page would inform travelers on the use of E-ZPass tags, the commercial use of the Parkway, etc.

Real-time information would include data such as: the travel time or average speeds in major segments of the Parkway; locations of accidents and other traffic incidents; estimated delays at mainline toll plazas during peak periods or when there are major events at the arts center; and the occupancy of the park and ride lots and the estimated time that a lot would be full.

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
○	Reduces Recurring Delay	The Parkway home page will contain information which may encourage travelers to shift some trips to less congested time periods.
○	Increases Revenues	The data collected through the home page surveys may be used to better market the Parkway's services or sold to other organizations.
○	Promotes Transit Ridership	A minor benefit of establishing a Parkway home page is the ability to educate users about the transit services available on the Parkway and the schedules for these services.
●	Promotes Better Use of Parkway Resources	Better use of the Parkway's resources can be encouraged by giving on-line users access to real-time traffic information, service plaza locations, park-and-ride lot locations, transit services, and the use of the Parkway to major tourist attractions in New Jersey.
	Indirect Benefits	
○	Provides Data for Planning and Operations	A Parkway home page may be a very useful tool for conducting traveler surveys and collecting Parkway traveler information to support planning and operations.
○	Shifts Travel to Less Congested Time Periods	The Parkway home page will contain travel time or other information which may encourage travelers to shift some trips to less congested time periods.
○	Promotes Inter-modal/Inter-agency Operations	Another minor benefit of the home page is that it provides Park & Ride and tourist information. Home pages may be provide links to other operating agencies to provide a virtual network of transportation information.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

It was assumed that the day-to-day maintenance of the TOC web site would not be accomplished by existing TOC personal, but would need maintenance personnel to keep up with all changes, and problems that surface.

It was determined that it would be more cost effective in the long run if the TOC purchased its own computer to house the web site, instead of leasing hard drive space on a monthly basis. This project would certainly be long term, and last the life of the computer, which is less expensive than utilizing leased space.

Once the page has been designed and it is up an running, it was determined that daily maintenance and operation will necessitate 2-4 hours per day. This will include updating all information within the page, updating all related links, general maintenance and overall operation of the service.

A total cost for this project was estimated to be $67,000. Considering variables such as type of web page, extent of services provided by the web page, and type of hardware type, a cost range of $37,000 to $67,000 was derived. See cost estimate on the following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Establish a Parkway Home Page with Real-time Traveler Information

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
6. Home Page					
Hardware					
Computer	LS	$7,000	1	$7,000	
Video input	LS	$2,500	1	$2,500	
Modem	EA	$650	1	$650	
Server Interface card	EA	$200	1	$200	
Subtotal				$10,350	
Software					
Page Design	LS	$2,100	1	$2,100	
Subtotal				$2,100	
Operation and Maintenance					
Operations	YR	$1,712,000	0.03	$51,360	
Maintenance	YR	$3,000	1	$3,000	Includes allocation for parts
Subtotal				$54,360	
Project Total				**$66,810**	

December 22, 1997

UPGRADE THE PARKWAY TRAFFIC OPERATIONS CENTER

DESCRIPTION:

Many of the other projects identified elsewhere in this plan require complementary improvements to the NJHA Communications Center. These projects would result in its evolution to a true Traffic Operations Center (TOC). The functional responsibilities of the enhanced TOC would include:

- processing the travel time data from E-ZPass tag readers,
- transmitting of the travel time and average speed data to TRANSCOM,
- updating static and dynamic data on the web page,
- dispatching assistance to disabled vehicles reported through the call-in system,
- monitoring activities at the park and ride lots,
- viewing the images on the CCTV monitors,
- posting appropriate messages on the HAR and VMS systems,
- exchanging data on accidents and incidents with other operators that may affect their agencies' operations,
- processing and forwarding E-ZPass readings from buses to the bus operators, and
- forwarding requests for bus service at the park and ride lots to the bus operators.

The project would identify the software, hardware and space requirements and other physical features needed for the efficient operation of the systems that are needed to fulfill these responsibilities.

BENEFITS:

Major/ Minor	Benefit	Description
		Direct Benefits
●	Reduces Incident Related Delay	Upgrades to the Traffic Operations Center (TOC) would provide the centralized equipment required to operate the CCTV cameras, detectors, TRANSMIT surveillance equipment, variable message signs (VMS), and highway advisory radio (HAR) and improve the overall dispatching of State Police, Operations and Maintenance services. These surveillance and dissemination devices operated in an integrated traffic management system will result in significant reductions in total vehicle-hours of incident-related delay.
○	Reduces Recurring Delay	Reductions in recurring delay may be possible by helping motorists optimize the routes used for their commute trips.
●	Improves Safety	By detecting and verifying roadway incidents more quickly and efficiently, the incident response time can be reduced. This will result in improved motorist safety due to more prompt medical, fire, and police attention; and reduced secondary accidents.
○	Improves Transit Vehicle Location Monitoring	The upgrades to the Traffic Operations Center will include the central equipment for storing the E-ZPass tag data that will be used by the transit operators to monitor bus locations (see Project 9).
○	Reduces Transit Field Supervision	By using the CCTV and data resources of the Traffic Operations Center, transit operators may supervise their vehicles from this central location, and require less field supervision.
		Indirect Benefits
○	Provides Data for Planning and Operations	Improved data will facilitate the operations of the Parkway and the planning of new projects in the Parkway corridor.
●	Promotes Inter-modal/Inter-agency Operations	A major benefit of upgrading the Traffic Operations Center with centralized equipment for vehicle monitoring is the ability to enhance inter-modal operations and inter-agency coordination and communication.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

Upgrades to the Parkway Traffic Operations Center include modifications necessary to greatly increase the building space allotted to traffic operations. The increase in space includes expansion necessary to house all of the computer systems required to operate and maintain the individual projects detailed within this report. Additional space has also been created to establish an overall efficient operations center, that is not constricted and will provide room for future expansion.

The only computer system that would be included in the cost estimate for the TOC would be the installation of a new Local Area Network (LAN), and all of the other related hardware needed to operate the LAN. The other computers associated with the individual projects are found in the associated project cost estimate. Desktop, or personnel computers used within the Traffic Operations Center will be bought through yearly overhead costs.

The estimated cost of this project was calculated to be $2,329,000. This is for a basic new structure. Considering variable such as construction costs, labor costs, and materials costs, a cost range of $1,808,000 to $2,329,000 was derived. The lower end cost relates to a Traffic Operations Center that shares space with another building. The higher cost is for a separate TOC. See cost estimates on the following pages.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Upgrade the Parkway Traffic Operations Center

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Source	Assumptions
7. TOC - shared facility						
Building / Share						
Structure	SF	$135	8750	$1,181,250	Florida DOT/Estimate	Entire structure/rough-in/HVAC/Etc.
Utility Hook-up	LS	$22,500	1	$22,500	Means	
Equipment Com. tie-in	LS	$18,000	1	$18,000	Means	
Phone System	LS	$36,500	1	$36,500	Estimate	
Radio System	LS	$17,000	1	$17,000	Estimate	
Subtotal				$1,275,250		
Control Room						
Workstation - primary	EA	$14,850	1	$14,850	VDOT Bid	
Workstation - secondary	EA	$12,900	1	$12,900	VDOT Bid	
Rough-in video wall/equip. Rm.	LS	$6,000	1	$6,000	VDOT Bid	
Video Wall	LS	$47,000	1	$47,000	VDOT Bid	
Graphics Projector/Screen	LS	$22,000	1	$22,000	Distributer/Fure View Inc.	
Subtotal				$102,750		
Offices/Finish/Furnish						
Conference Room	LS	$5,000	1	$5,000	Estimate	
Office Cubes	EA	$9,000	6	$54,000	NJ Route One Estimate	
TOC Manager	LS	$5,000	1	$5,000	Estimate	
Agency Representatives	LS	$7,500	2	$15,000	Estimate	
Lobby	LS	$4,500	1	$4,500	Estimate	
Subtotal				$83,500		
Misc. Construction/Furn						
				$0		
Subtotal				$0		
Computer/Equipment Rm						
Equip. Rack system	LS	$2,500	4	$10,000	Penn-Lincoln Estimate	
Utility rough-in	LS	$1,500	1	$1,500	Estimate	
Lighting	LS	$600	1	$600	Estimate	
Workstations	EA	$4,220	2	$8,440	Estimate	
Furniture - misc	LS	$2,000	1	$2,000	Estimate	
Subtotal				$22,540		
Computers/Com equip.						
LAN Server	LS	$15,000	1	$15,000	Penn-Lincoln Estimate	
LAN Wiring Assembly	LS	$20,000	1	$20,000	Penn-Lincoln Estimate	
Fiber Com Equipment	LS	$60,000	1	$60,000	Estimate/Harris	
Server Switch	LS	$1,850	1	$1,850	Route One System	
UPS	LS	$30,000	1	$30,000	Estimate/Harris	
Alarm Computer	LS	$10,000	6	$60,000	Estimate/Harris	
Router	EA	$5,000	1	$5,000	Penn-Lincoln Estimate	
Network Printer	EA	$2,320	2	$4,640	CompUSA	
Laser Printer	EA	$2,000	2	$4,000	CompUSA	
Log Printer	EA	$500	2	$1,000	CompUSA	
LAN Transceiver	EA	$500	1	$500	Estimate	
Communications Tower	EA	$26,200	1	$26,200	Estimate	
Subtotal				$228,190		
Operations and Maintenance						
Operations	YR	$1,712,000	0.04	$68,480		
Maintenance	YR	$27,000	1	$27,000		Includes allocation for parts
Subtotal				$95,480		
Project Total				**$1,807,710**		

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Upgrade the Parkway Traffic Operations Center

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Source	Assumptions
7B. New TOC Facility						
New Building						
Structure	SF	$187	8750	$1,636,250	Florida Dot Design Guide/I-64 - VDOT	Entire structure/rough-in/bathrooms/HVAC/Etc.
Utility Hook-up	LS	$22,500	1	$22,500	Means	
Equipment Com. tie-in	LS	$18,000	1	$18,000	Means	
Phone System	LS	$36,500	1	$36,500	Estimate	Automated
Radio System	LS	$17,000	1	$17,000	Estimate	
Subtotal				$1,730,250		
Site Work						
Land Purchase	Ac	$40,000	1	$40,000	Estimate	
Site Preparation	LS	$1,040	1	$1,040	Means	
Clearing and Grubbing	Ac	$6,700	1	$6,700	Means	
Earthwork	LS	$9,700	1	$9,700	Means	Shaping/fine grading/etc.
Sewerage and Drainage	LS	$31,405	1	$31,405	Means	
Paving and Surfacing	SF	$13	15,000	$195,000	AASCO Paving/Harris	Curb/Gutter/Striping/Etc.
Landscaping	LS	$9,700	1	$9,700	Means	
Subtotal				$293,545		
Control Room						
Workstation - Primary	EA	$14,850	2	$29,700	VDOT Bid	
Workstation - Secondary	EA	$12,900	2	$25,800	VDOT Bid	
Rough-in video wall/equip. Rm.	LS	$6,000	1	$6,000	VDOT Bid	
Video Wall	LS	$47,000	1	$47,000	VDOT Bid	
Graphics projector/Screen	LS	$22,000	1	$31,000	Distributer/Fure View, Inc.	
Subtotal				$139,500		
Offices/Finish/Furnish						
Conference Room	LS	$5,000	1	$5,000	Estimate	Furniture/Chairs
Office Cubes	EA	$9,000	6	$54,000	NJ Route one Estimate	
TOC Manager	LS	$5,000	1	$5,000	Estimate	Table/Chairs/Misc
Agency Representatives	LS	$7,500	2	$15,000	Estimate	
Lobby	LS	$16,000	1	$16,000	Estimate	
Subtotal				$95,000		
Misc Construction/Furn						
Bathrooms -2	LS	$18,400	1	$18,400	Means	
Subtotal				$18,400		
Computer/Equipment Rm						
Equip. Rack system	EA	$2,500	4	$10,000	Penn-Lincoln Estimate	
Utility rough-in	LS	$1,500	1	$1,500	Estimate	
Lighting	LS	$600	1	$600	Estimate	
Workstations	EA	$4,220	2	$8,440	Estimate	
Furniture - misc	LS	$2,000	1	$2,000	Estimate	
Subtotal				$22,540		
Computers/Com equip.						
LAN Server	LS	$15,000	1	$15,000	Penn-lincoln Estimate	
LAN Wiring Assembly	LS	$20,000	1	$20,000	Penn-lincoln Estimate	
Fiber Com Equipment	LS	$60,000	1	$60,000	Estimate/Harris	
Server Switch	LS	$1,850	1	$1,850	Route One System	
UPS	LS	$30,000	1	$30,000	Estimate/Harris	
Alarm Computer	LS	$10,000	6	$60,000	Estimate/Harris	
Router	EA	$5,000	1	$5,000	Penn-Lincoln Estimate	
Network Printer	EA	$2,320	2	$4,640	CompUSA	
Laser Printer	EA	$2,000	2	$4,000	CompUSA	
Log Printer	EA	$500	2	$1,000	CompUSA	
LAN Transceiver	EA	$500	1	$500	Estimate	
Communications Tower	EA	$26,200	1	$26,200	Estimate	
Subtotal				$228,190		
Operations and Maintenance						
Operations	YR	$1,712,000	0.04	$68,480		
Maintenance	YR	$27,000	1	$27,000		Includes allocation for parts
Subtotal				$95,480		
Project Total				**$2,329,360**		

December 22, 1997

ENHANCE MANAGEMENT OF PARK & RIDE LOTS WITH ETTM TECHNOLOGY

DESCRIPTION:

The cost of new park and ride facilities and upgrades to the existing park and ride facilities and other ITS improvements would be offset through the collection of parking fees. In order to minimize the costs of this operation, the fees would be collected using the same E-ZPass tags that are used for toll collection. This project would implement the systems needed at the TOC for the monitoring of these facilities. This information would be used to change signing indicating that the lot is full on the roads leading to the lot.

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
●	Increases Revenues	The operational improvements of an ITS-based parking system at Park & Ride lots is expected to bring an increase in revenues for the Parkway in the form of parking fees.
○	Reduces Roadway Expansion Requirements	By improving Park & Ride facilities and promoting inter-modal travel on the Parkway, needs for roadway expansion can be reduced.
○	Promotes Transit Ridership	One of the key impacts on transit ridership is accessibility and availability of convenient parking. A Park & Ride program which is self-supporting can be expanded as the needs arise, and coordinated with transit service improvements.
●	Improves Traveler Satisfaction & Sense of Security	Improvements to Park & Ride facilities are expected to have a large impact on traveler satisfaction, especially for daily commuters frustrated by inadequate parking facilities.
○	Promotes Better Use of Parkway Resources	By increasing the use of Park & Ride facilities, the people-moving capacity of the Parkway is increased.
	Indirect Benefits	
○	Provides Data for Planning and Operations	Implementation of the ITS-based parking system will allow time-based parking demand data to be automatically collected. This data can be used for planning and operations.
○	Reduces Environmental Impacts	Reductions in vehicle emissions will be realized due to use of inter-modal travel.
○	Promotes Inter-modal/Inter-agency Operations	Improvements to Park & Ride lots will benefit inter-modal operations on the Parkway by increasing the convenience of inter-modal travel.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

The cost estimate for this project was derived under the assumption that all the necessary E-Zpass readers and related equipment will be in place, and therefore this estimate does not include the installation and maintenance of this equipment.

It was also assumed that no major modifications are necessary in order for each of the ten lots to be outfitted for the fee-oriented system. In other words, minimal modifications would be needed in order to provide a one entrance/exit system for each of the lots. This would include any modifications to traffic deterrents such as medians, pavement, etc.

It was assumed that each Park and Ride lot would only need one additional E-ZPass reader to facilitate metered parking. This is under the assumption that one reader will be able to monitor all necessary traffic movements. If a second reader is needed at each lot, the total overall cost for this project will be greatly increased.

The estimated total for this project is $571,000. Considering variables such as lot configurations, signs needed, and other site modifications that might be necessary, a cost range of $305,000 to $688,000 was derived. See cost estimate on following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Enhance Management of Park & Ride Lots with ETTM Technology

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
8. ITS/Park and Ride Improvements					
Central Equipment					
Computer	EA	$11,500	1	$11,500	
Software	LS	$75,000	1	$75,000	
Server interface card		$200	1	$200	
Modem	EA	$675	1	$675	
Subtotal				$87,375	
Lot Equipment/Mods					
Lot Modifications	LS	$14,500	10	$145,000	Modify for fee-oriented park - in need
Gate System	EA	$3,525	20	$70,500	10 lots - 2 per lot
Pavement markings	LS	$500	10	$5,000	
Notification sign	EA	$600	20	$12,000	"E-ZPass only"
Subtotal				$232,500	
Communications					
Tie-in to existing back bone	EA	$12,500	10	$125,000	
Subtotal				$125,000	
Operations and Maintenance					
Operations	YR	$1,712,000	0.06	$102,720	
Maintenance	YR	$232,500	0.1	$23,250	10 percent of initial equipment
Subtotal				$125,970	
Project Total				**$570,845**	

December 22, 1997

OPERATE A BUS LOCATION SYSTEM WITH ETTM TECHNOLOGY

DESCRIPTION:

Although NJ Transit has tested a bus location system, it has no immediate plans to deploy such a system on their fleet. However, it is using E-ZPass tags to identify buses approaching the Port Authority Bus Terminal. The proposed project would utilize tags in a similar way to periodically identify the location of buses on the Garden State Parkway. The position of buses between reader positions can be approximated from the time the bus passed the upstream tag reader and the average speed of traffic between readers. With this knowledge, the bus operators can decide what actions to take when they receive requests for service at a park and ride lot not normally served. (see the next project) The bus operators could also inform waiting passengers of long service delays resulting from bad weather or accidents.

This project would prepare the overall design for the system based on the participation of the NJHA, NJ TRANSIT, and the other transit operators in the corridor.

BENEFITS:

Major/ Minor	Benefit	Description
Direct Benefits		
○	Reduces Operating Costs	A cost-effective bus location system using E-ZPass toll tags will reduce transit operating costs by improving centralized monitoring of transit operations.
○	Promotes Transit Ridership	To the extent that transit service and scheduling is improved by the bus locating system, transit ridership will be promoted. The bottom line benefit is improved reliability and quality of bus service along the Parkway.
●	Improves Transit Vehicle Location Monitoring	Although there are no plans to implement a highly accurate GPS (Global Positioning System) based bus location system for buses on the Parkway, the approximate location of buses can be determined using E-ZPass tags and tag readers. This would greatly improve the ability to locate buses and improve centralized transit operations.
○	Reduces Transit Field Supervision	By giving central transit operators access to approximate bus locations, the need for field supervision is reduced.
Indirect Benefits		
○	Provides Data for Planning and Operations	Implementation of the bus locating system will provide data which will be valuable for transit planning and operations. One immediate benefit may be in using this data to optimize bus scheduling.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

This project cost estimate is under the basic assumption that the E-ZPass system would already be installed, and these related costs are associated with the E-ZPass system, and found under that particular cost estimate. Therefore, it is assumed that no further installation of E-ZPass readers would be needed, and that there will be no additional equipment costs.

However, costs will be incurred for maintenance and operations of the system. All maintenance costs will be related to system equipment located at the Traffic Operations Center.

The estimated cost for this project is $115,000. Considering variables such as system maintenance and operations, a cost range of $32,000 to $115,00 was derived. See cost estimate of the following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Operate a Bus Location System with ETTM Technology

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
9. E-ZPass/Bus Location System					
Computers/Hardware					
Software	LS	$10,000	1	$10,000	
Subtotal				$10,000	
Bus Communications					
Subtotal					
Operations and Maintenanc					
Operations	YR	$1,712,000	0.06	$102,720	
Maintenance	YR	$2,500	1	$2,500	Includes allocation for parts
Subtotal				$105,220	
Project Total				**$115,220**	

December 22, 1997

* This project will utilize the E-ZPass system for detailing bus traffic, and will not require any additional funding by NJHA. Any additional costs will be covered by the individual bus companies using the location system.

OPERATE A STOP-ON-DEMAND BUS SERVICE THROUGH PARK AND RIDE LOTS

DESCRIPTION:

Bus operations and modal transfers can be encouraged and facilitated by making it possible for travelers to request bus service at park and ride areas. These bus services would be provided by bus routes that do not normally stop at the park and ride area, or routes that only stop at the park and ride area at other times of day. This project would develop a system for identifying when and where a bus patron has requested service, relaying this information to the appropriate bus service provider, communicating this request for service to the driver, receiving an acknowledgment of the request from the driver, and communicating the anticipated arrival time of the bus to the patron.

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
●	Reduces Operating Costs	The system developed under this project would allow bus drivers to bypass bus stops where no one is waiting to be picked up. This will result in significant reductions in operating costs. On an annualized basis, bus-miles are very expensive and present significant opportunities for cost savings.
○	Increases Revenues	By providing more responsive and reliable bus service at the Park & Ride lots, revenues can be increased through promotion of ridership.
○	Reduces Roadway Expansion Requirements	To the extent that inter-modal transportation is encouraged by improved bus service, the requirements for roadway expansion in the Parkway corridor will be reduced.
●	Promotes Transit Ridership	A major benefit of on-demand routing of buses into Park & Ride lots will be improved customer service and promotion of transit ridership. Reliability and convenience are important for gaining ridership.
○	Reduces Transit Field Supervision	This project will include an automated system for identifying when and where a bus patron has requested service, thus reducing the need for transit field supervision.
●	Improves Traveler Satisfaction & Sense of Security	By automating patron requests for bus service at Park & Ride facilities, travelers will be assured that service is prompt and reliable. These features will give the riders more satisfaction and increased sense of security.
○	Promotes Better Use of Parkway Resources	By increasing the efficiency of the existing Park & Ride facilities, the people-moving capacity of the Parkway will be increased.
	Indirect Benefits	
○	Reduces Environmental Impacts	Reductions in vehicle emissions will be realized due to use of inter-modal travel.
●	Promotes Inter-modal/Inter-agency Operations	On-demand routing of buses to Park & Ride lots will benefit inter-modal operations on the Parkway by automating requests for bus service providers.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

This project would also utilize the existing fiber optic back bone as its primary means of communication. It is assumed that an awaiting bus passenger will signal the bus operations center via a small signaling station located at each of the designated areas. This message would be direct-dialed and sent via the back bone to a bus operator, which would in turn contact bus drivers, and possibly related signs, as well as provide notification to the awaiting passenger that the request was received.

Each of the ride-request stations would be a low-end kiosk, with signaling capabilities to notify the bus operator of an awaiting passenger. The notification would be accomplished via a direct-dial line that would be linked to each of the associated bus companies operation centers. It is assumed that no further communications installations or modifications would need to be installed in order for the system to operate, making use of the existing fiber optic back-bone.

The project cost estimate also assumes that the bus company will not need to make any modifications to their current communications system between the bus operator and the bus driver. However, it is assumed that the bus companies will install necessary communications equipment to provide the direct-dial service.

The estimated cost for this project $403,000. Considering variables such as equipment costs, communications improvements, and level of NJHA evolvement with this project, a cost range of $324,000 to $403,000 was derived. See cost estimate on the following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Operate a Stop-on-demand Bus Service Through Park & Ride Lots

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
10. Bus Routing into Park & Ride Lots					
Bus Operations Centers					
Computer	EA	$2,200	4	$8,800	4 bus companies
Modem	EA	$815	4	$3,260	
Software	LS	$42,000	1	$42,000	
Subtotal				$54,060	
Bus Signaling Station					
Signaling Station	EA	$16,000	10	$160,000	Kiosk/notification sign/map/etc.
Subtotal				$160,000	
Communications					
Tie-in to back bone	EA	$12,500	10	$125,000	
Subtotal				$125,000	
Operations and Maintenance					
Operations	YR	$1,712,000	0.03	$51,360	
Maintenance	YR	$160,000	0.08	$12,800	8% of field equipment
Subtotal				$64,160	
Project Total				**$403,220**	

December 22, 1997

DISPLAY REAL-TIME TRANSIT SCHEDULE INFORMATION AT PARK & RIDE LOTS

DESCRIPTION:

The preceding projects lay the foundation for a system that would enhance customer confidence in the transit system by offering real time schedule information on bus arrivals at the park and ride lots.

The information display at the park and ride lot would indicate the names/numbers of the bus routes serving that park and ride lot, and the estimated arrival time of the next bus on each route. The project would determine the most appropriate display device, the procedures and requirements for communicating with the device, and the means of storing the data and canceling (and updating) the message as each bus passes through the park and ride lot. This system design must be flexible enough to accommodate information from multiple transit operators serving the same facility, and may also be part of the interface for the passengers who request service from a bus that would not otherwise stop at that location. (See the project description for "Operate a Stop - on-Demand Bus Service Through Park and Ride Lots.")

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
○	Increases Revenues	Transit revenues are expected to increase as a result of increased ridership.
○	Reduces Roadway Expansion Requirements	This project may provide reductions in roadway expansion requirements by promoting reliable transit service within the Parkway corridor.
●	Promotes Transit Ridership	A major benefit of real time transit schedule information will be promotion of transit ridership through reliable transit service.
●	Improves Traveler Satisfaction & Sense of Security	By providing real time transit schedule information, Park & Ride lot patrons will benefit from knowing whether the transit service is on-time. If the service is running a little behind, as it inevitably will from time to time, the patron will know the approximate time of arrival and what impacts this delay will have on their trip. It is this information which will increase rider satisfaction and sense of security.
○	Promotes Better Use of Parkway Resources	By increasing the efficiency of the existing Park & Ride facilities and inter-modal travel, the people-moving capacity of the Parkway will be increased.
	Indirect Benefits	
○	Reduces Environmental Impacts	Marginal reductions in vehicle emissions will be realized due to use of inter-modal travel.
●	Promotes Inter-modal/Inter-agency Operations	Real time transit information will increase multi-modal trips in the corridor.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

This project cost estimate was developed under the assumption that E-ZPass readers, estimated in a previous project, will be installed in each of the Park and Ride lots. It is these readers, coupled with the main line readers that provide real time information concerning the bus traffic along the Garden State Parkway. The readers will notify the computer at the Traffic Operations Center when a bus is entering and exiting a park and ride lot.

The most significant cost to this project will be the type of signs. It was assumed that small flip disk Variable Message Signs would be used at each of the lots to convey the transit and travel time information. If different signs are used, the cost will significantly vary.

The estimated cost for this project is $1,316,000. Considering variables such as sign type to be used, communications, and equipment costs, a cost range of $1,000,000 to $1,397,000 was derived.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Display Real-time Transit Schedule Information at Park & Ride Lots

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
11. Real-time Transit Schedule					
Central Equipment					
Computer	EA	$11,500	1	$11,500	
Modems	EA	$1,100	1	$1,100	
Software	LS	$85,000	1	$85,000	
Subtotal				$97,600	
Park and Ride Lots					
Display Signs	EA	$65,000	10	$650,000	Small VMS
Structure	EA	$7,100	10	$71,000	
Controller	EA	$2,890	10	$28,900	
Cabinet	EA	$2,400	10	$24,000	
Modems	EA	$900	10	$9,000	
Subtotal				$782,900	
Communications					
Tie-in to existing back bone	EA	$12,500	10	$125,000	
Subtotal				$125,000	
Operations and Maintenanc					
Operations	YR	$1,712,000	0.14	$239,680	
Maintenance	YR	$782,900	0.09	$70,500	9 percent of field equipment
Subtotal				$310,180	
Project Total				**$1,315,680**	

December 22, 1997

OPERATE INFORMATION KIOSKS AT THE SERVICE AREAS (PRIVATE SECTOR)

DESCRIPTION:

TRANSCOM is currently developing mechanisms for the dissemination of data through information kiosks. This project would support these and other efforts to put useful information at the finger tips of travelers on the Parkway through additional information kiosks at the service areas and park and ride areas. It is anticipated that this information would allow travelers to: make advance room reservations; buy tickets for activities at the Garden State Arts Center and other venues; get detailed directions to the destinations of their choosing; and obtain other travel related services. The involvement of the private sector is an essential part of the deployment of ITS services.

BENEFITS:

Major/ Minor	Benefit	Description
	Direct Benefits	
●	Improves Traveler Satisfaction & Sense of Security	The service areas along the Parkway have a high volume of travelers who are not regular patrons living in the corridor. Information kiosks at these service areas will assist travelers in making advance room reservations, buying tickets for travel and activities, getting detail directions to their destination, and will provide other travel services. The convenience of these kiosk services will greatly enhance satisfaction for Parkway travelers.
	Indirect Benefits	
○	Reduces Environmental Impacts	This project may reduce in emissions due to improved trip planning and other travel services provided at the kiosks.
○	Promotes Inter-modal/Inter-agency Operations	By providing inter-modal travel information and ticket purchasing at the service areas and at the Park & Ride lots, inter-modal operations will be promoted.

●=Major Benefit ○=Minor Benefit

ASSUMPTIONS:

Again, the communications cost estimate is based on the assumption that the fiber optic back bone will be in place. An estimated cost to tie-in each of the kiosks was established along with the rest of the equipment tie in costs. An average cost o $12,500 was derived for each piece of equipment that needed to be tied into the back bone.

It was assumed that the kiosks would be installed at a total of 22 different locations along the Garden State Parkway. As with all other projects, this total may vary along with final project costs.

The estimated total cost for this project is $1,197,000. Considering variable such as number of kiosks, type of equipment, and cost of communications tie-in, a cost range of $583,000 to $1,266,000 was derived. See cost estimate on following page.

New Jersey Highway Authority
Early Deployment Study
Project Cost Estimates

Project: Operate Information Kiosks at the Service Areas (Private Sector)

Item	Unit	Unit Cost	Quantity/Range	Cost/Range	Assumptions
12. Operate Information Kiosks					
Central Equipment					
Computer	EA	$11,500	1	$11,500	
Software	LS	$40,000	1	$40,000	
Server interface card	EA	$900	1	$900	
Modem	EA	$900	1	$900	
Subtotal				$53,300	
Kiosks					
Unit	EA	$10,500	22	$231,000	Structure/enclosure
Computer	EA	$11,000	22	$242,000	
Monitors - touch screen	EA	$5,100	44	$224,400	
Modem	EA	$675	22	$14,850	
Subtotal				$712,250	
Communications					
Tie-in to back-bone	EA	$12,500	22	$275,000	
Subtotal				$275,000	
Operations and Maintenan					
Operations	YR	$1,712,000	0.05	$85,600	
Maintenance	YR	$712,250	0.1	$71,000	10 percent of initial equipment cost
Subtotal				$156,600	
Project Cost				**$1,197,150**	

October 23, 1997